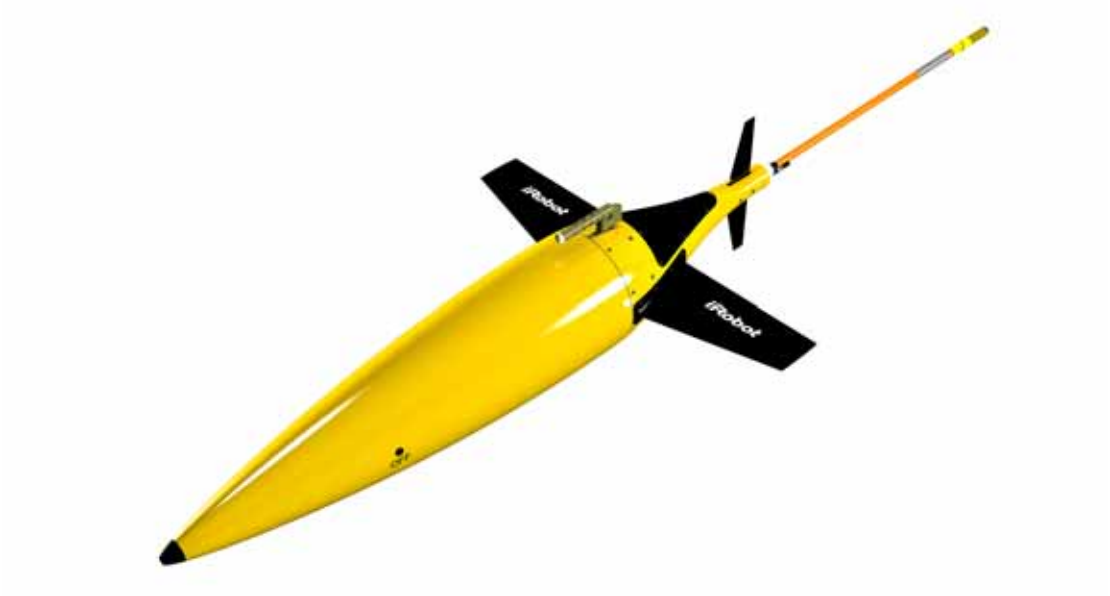
iRobot®

1KA Seaglider™

User's Guide



Part Number: 4220126

Revision: D

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Table G-1. Quantity of screws to attach nose plates..... 320

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Introduction

Audience

The *1KA Seaglider User's Guide* is for qualified and authorized Seaglider pilots and field personnel only. It provides an overview of the operating principles and instructions for assembling, testing and piloting Seagliders as well as basic guidelines for launching and recovering. Launch and recovery methods vary with company and facility.

Typographical conventions

The following table explains the typographical conventions used in this manual.

Typeface	Indicates	Example
UPPERCASE BOLD	Parameters used to control the operations of the 1KA Seaglider; includes a leading **$** sign.	(**$T_DIVE**)
bold	Items you select, (such as menu options and commands) or choose from a list.	Select **1** from the menu**,** and then click Edit.
`monospace`	User input and filenames.	`/etc/vx/tunefstab`
italic	Variables, titles, first occurrence of terms.	*`Variable name`*.
Tab > Command Group > Command	Command option paths are written in the order you access a command button from the ribbon	**Edit** > **Insert** > **Insert file**

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Safety conventions

The level of a safety notice is determined by the level of physical harm that could occur, the safety critical function, and the severity and probability that harm will occur. This manual complies with the following industry-standards for safety notices.

Danger. Indicates a definite hazardous situation, which if not avoided, will result in death or serious injury to personnel. The 1KA Seaglider rarely poses a risk at this level.

Warning. Identifies a clear danger for injury or death to the person doing that procedure. Immediate action is required to avoid harm.

Caution. Identifies risk of damage to the equipment. Immediate action is required to avoid a potentially hazardous situation.

NOTE: Alerts personnel of an unsafe equipment practice or additional information.

Safety information

Be aware of the following types of safety hazards.

Personal safety information

WARNING:

- As shipped, the Seaglider chassis weighs approximately 120 lbs (52 kg) dry and is capable of inflicting personal injury to body parts. When removing Seaglider from the shipping container, use extreme caution to avoid personal injury or equipment damage.
- Seaglider should be carried by two people. Each person should hold one end of the cradle. To prevent back injury, lift with your legs instead of your back.

Vehicle hazards

WARNING:

Before performing maintenance procedures, make sure that the vehicle is powered off. Serious injury can occur if the power supply of the 1KA Seaglider is intact while maintenance is being performed.

Battery safety

Seaglider uses (1) 24V lithium primary battery pack and (1) 10V lithium primary battery pack.

WARNING:

Release of toxic gases/materials due to battery exposure to fire can cause death or injury.

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Registration

To access user information on the iRobot web site, you must register your Seaglider. To register your product and establish a user ID and a password, go to the iRobot website at:

http://gisupport.irobot.com/app/utils/login_form

iRobot contact information

Customer support

For iRobot Maritime Applications Support, send an e-mail to: maritimesupport@irobot.com.

Sales

To obtain pricing information or to order spares, options, accessories, or training, send an e-mail to maritimesales@irobot.com or call 888-776-2687 (Toll free in the USA) or +(1) 781-430-3090 (International customers).

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CHAPTER 1

1KA Seaglider History and Overview

Seaglider history

The history of buoyancy-driven oceanographic instruments begins with Archimedes (287 BCE–212 BCE). He is considered the father of hydrostatics, static mechanics, and integral calculus. Archimedes' Principle is the basis for all buoyancy driven vehicles. It states that the buoyant (upward) force on a submerged object is equal to the weight of the fluid that the object displaces. This fact is used in the variable mass, fixed volume (ballast) control systems of modern submarines and submersibles, and in the fixed mass, variable volume control systems of small profiling oceanographic instruments.

The use of buoyancy control in oceanographic instruments dates from the mid-1950s. By 1955, Henry Stommel of the Woods Hole Oceanographic Institution and John Swallow in the United Kingdom had ideas for neutrally buoyant floats whose positions could be tracked acoustically. Swallow was the first to build such a device, which contained a free-running 10 kHz acoustic source and was tracked from a surface ship. By the 1970s, transponding versions running at 3-4 kHz had extended shipboard detection ranges to 50 km, and a 200 Hz version used the Sound Fixing and Ranging (SOFAR) sound channel (Stommel's original idea) to remove the requirement for ship-based tracking.

By the 1980s, Tom Rossby at URI had developed the inverse of the SOFAR float (called RAFOS, SOFAR spelled backwards) that relied on moored sound sources and an acoustic receiver on the float. By adding a compressee (an object whose compressibility is approximately the same as that of seawater), these floats could also be ballasted to follow a particular density surface, rather than a pressure surface. About the same time, John Dahlen's group at Charles Stark Draper Laboratory developed a moored profiler that used a variable buoyancy device to propel itself up and down along the mooring wire, measuring temperature, conductivity and currents.

In the 1990s, Russ Davis and his group at Scripps Institution of Oceanography added a variable-buoyancy device to a neutrally buoyant float to create profiling floats. These floats (called Autonomous Lagrangian Current Explorers, or ALACE) had the ability to inflate an external bladder, thereby changing their displaced volume, but not their mass. The resulting buoyancy force allowed the float to make profile measurements from its neutrally buoyant depth to the surface. At the surface, position and profile data were transmitted via the Service ARGOS satellite system. By the year 2000, hundreds of this type of float were deployed worldwide, both of the Scripps design and a design from Webb Research Corporation (now Teledyne Webb Research) of East Falmouth, Massachusetts.

Today's gliders share a common heritage: Henry Stommel's vision, published in 1989 in *Oceanography* [Stommel, 1989]. Stommel imagined a fleet of vehicles that "...migrate vertically through the

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ocean by changing ballast, and they can be steered horizontally by gliding on wings. During brief moments at the surface, they transmit their accumulated data and receive instructions. Their speed is about 0.5 knot." A prototype gliding vehicle was fielded as early as 1991 by Webb Research Corporation (WRC). This vehicle demonstrated the basic configuration of future gliders.

A few years later, the Office of Naval Research-sponsored Autonomous Ocean Sensing Network (AOSN) program, led by Tom Curtin, sponsored three groups to develop autonomous underwater gliders.

All groups worked with similar design goals:

- Small enough to be handled by two people
- Relatively low acquisition and operation costs
- Horizontal speeds of around 30 cm/s
- Endurance of up to a year
- GPS positioning
- Two-way data telemetry at the surface
- Basic sensor payloads, including a Conductivity, Temperature, and Density

By the year 2000, all groups had operational models that addressed these design goals:

- Slocum: developed by Webb Research Corporation
- Spray: developed by a team of scientists from Scripps Institution of Oceanography (Russ Davis) and Woods Hole Oceanographic Institution (Breck Owens)
- Seaglider: developed at the University of Washington (Charlie Eriksen)

The development of the autonomous Seaglider has greatly extended the density of hydrographic observations at orders of magnitude lower cost than is possible with ships and moorings. The construction cost of a Seaglider is equivalent to a few days of a UNOLS open ocean ship time and its annual operational cost is less than a day of the same.

This guide describes operating Seaglider, the vehicle developed by the University of Washington School of Oceanography and the Applied Physics Laboratory, now licensed to iRobot Corporation for manufacture.

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System overview

Seaglider is an Unmanned Underwater Vehicle (UUV) designed for use in oceanographic missions lasting multiple months and covering up to 4600 km at depths ranging from 50 to 1000 m.

Seaglider travels underwater in a sawtooth pattern. The vertical velocity component of the sawtooth pattern comes from the onboard buoyancy engine changing the density while the horizontal velocity component comes from the lift provided by the wings and, to a much lesser extent, the body.

Seaglider runs on the PicoDOS operating system and can be reprogrammed and redirected from its basestation at any time, receiving the new commands when it surfaces.

Figure 1-1 shows the parts (land side and field side) of the Seaglider system and how they communicate with one another via Iridium satellite.

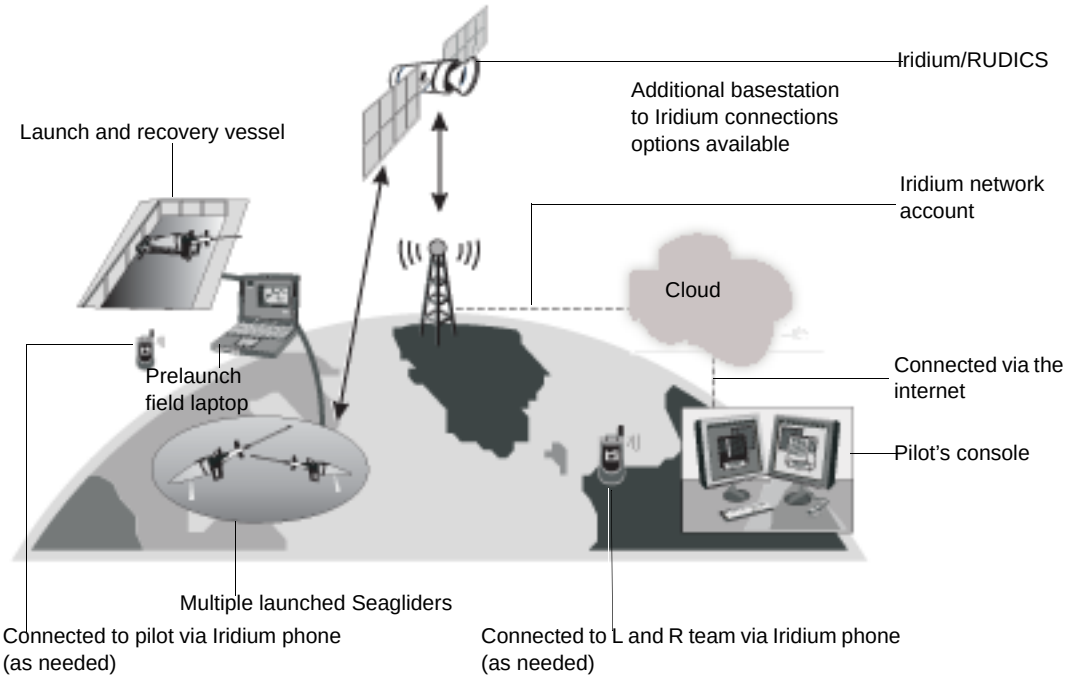

Iridium/RUDICS
Additional basestation to Iridium connections options available
Launch and recovery vessel
Iridium network account
Cloud
Prelaunch field laptop
Connected via the internet
Pilot's console
Multiple launched Seagliders
Connected to pilot via Iridium phone (as needed)
Connected to L and R team via Iridium phone (as needed)

Figure 1-1. 1KA Seaglider system overview

The field side consists of the following:

- Seaglider
- Field laptop used to check out Seaglider before deployment
- Field team

The land side consists of the following:

- Hosted cloud basestation running the Linux® operating system
- RUDICS

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- Pilot team
- Basestation interface computer

Seaglider makes a phone call, and the signal is picked up by the Iridium satellite. The call is downloaded to the civilian Iridium ground station in Arizona. The call is then sent by the internet (RUDICS) to the basestation.

Seaglider sensors

Seaglider can be equipped with third-party sensors that measure conductivity, temperature, pressure, dissolved oxygen, fluorescence, currents, photosynthetically active radiation, and optical backscatter. Using satellite based communications, the system transmits collected data to the basestation each time it surfaces. The following sections describe the sensing devices.

Standard Seaglider sensor

The PAINE® strain-gauge pressure sensor, a third-party sensor, is installed as standard equipment in Seaglider.

Optional sensors

The following optional third-party sensors are installed in select Seagliders:

- Sea-Bird 43F dissolved oxygen sensor (pumped)
- Sea-Bird dissolved oxygen sensor (unpumped)
- Sea-Bird CT Sail
- Aanderaa dissolved oxygen
- WET Labs ECO Pucks™
- Photosynthetically Active Radiation (PAR) sensor
- Sea-Bird Glider Payload Conductivity Temperature Depth (GPCTD) sensor
- Acoustic Doppler Current Profiler (Nortek AD2CP-Glider)
- Imagenex 853ES Echosounder

The pilot controls the frequency of science data collection by specifying sensor sampling intervals.

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CHAPTER 2

Checking Out Crate Contents

Inspecting Seaglider system shipping container

The 1KA Seaglider is shipped in a reusable container that serves as a field transport and storage case (Figure 2-1). Your configuration may differ, depending on what you ordered.

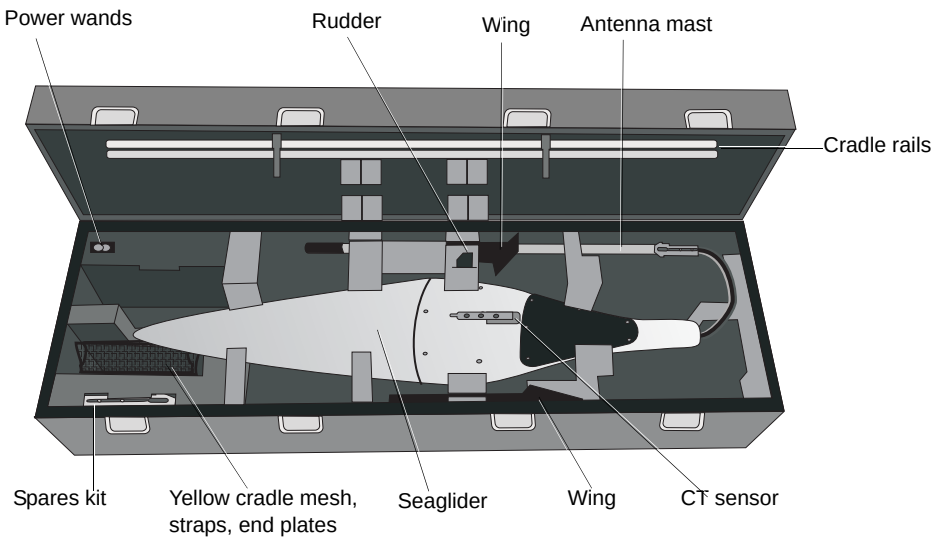


Figure 2-1. 1KA Seaglider system in open shipping case

Locate the following components in the shipping case:

- 1KA Seaglider body
- Sea-Bird Electronics conductivity and temperature (CT) sensor (installed on Seaglider body)
- Port and starboard wings (labeled)
- Rudder
- Antenna mast attached to rudder shoe
- Seaglider notebook containing trim sheets, sensor documentation, Seaglider serial number, and transponder frequency

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- Two magnetic power on/off wands
- Plastic spare parts box containing:
  - #2 Phillips head screw driver
  - Spare antenna connector O-rings
  - Two spare lead trim weights (5" long x ¾" wide x 1/8" thick)
  - Small vice grips
  - All screws necessary for assembly and spares

Optional components:

- Laptop computer for Seaglider communications
- 50 ft. non-powered communications cable
- Powered communications cable
- Launch and recovery cradle components (Figure 3-1)
  - Four aluminum rails
  - Yellow mesh
  - Two (2) end plates with carrying handles
  - Four (4) nylon straps (2 male, 2 female)
  - Assembly screws (8), washers (8), lock washers (8), wing nuts (4), eye screws (4) in a plastic bag.

If damage to your Seaglider occurred during transit, or if your shipment is incomplete, contact iRobot Maritime customer support at maritimesupport@irobot.com.

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CHAPTER 3

Setting Up the System

Setting up the basestation

The Seaglider basestation is the shore-side computer end of the Seaglider system. It is the computer that gliders call through the Iridium phone system; processes Seaglider data, producing scientific and engineering data; and performs simple error detection and notification.

The pilot does not have to sit at the basestation to control Seaglider, although they can.
Often the pilot accesses the basestation over the internet from another computer, Seaglider's interface computer (see "Setting up Seaglider's interface computer" on page 10). This setup allows the pilot to control Seaglider from anywhere there is internet access while Seaglider calls into the stationary basestation over the dedicated phone lines or internet via the RUDICS interface. iRobot recommends RUDICS service only.

Basestation configuration

The Seaglider basestation runs on a Linux® operating system (OS). The basestation software package consists of a collection of python scripts and a patched version of the XMODEM send and receive programs.

Seaglider pilots need to have write access in those Seaglider home directories to modify command and control files. At Seaglider login and logout, scripts are run to control and record aspects of the basestation transactions.

Basestation log in

To log into the basestation remotely, you need a user name, a password and the IP address of the basestation. When the basestation arrives from iRobot, the user name is set to *pilo*t and the initial password is *1qazxsw2*. It is recommended that you change this password immediately using the 'passwd' command.

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Internet configuration

Connect the basestation, properly configured for RUDICS, to the internet using a static and public IP address. If you need help, contact your IT department. The RUDICS port (configured by the user) will need to be opened through the firewall on the local machine as well as any firewalls between the basestation and the wide open internet. iRobot offers a turn-key solution with a host cloud basestation offering.

Setting up the basestation directories and files

After logging in to the basestation and connecting it to the internet, there are several things that you must check and set up.

Verify that Seaglider is commissioned on the basestation

1. Type **cd /home**, and then press Enter.
2. Type **ls**, and then press Enter.

   If the Seaglider has been commissioned on the basestation, a directory with the name for that Seaglider (for example, sg505) displays. All Seaglider names start with **sg**. The three digit number in the name is the serial number for the Seaglider system. The name is in the manual shipped with the Seaglider system. The serial number is also written in black on the rear of the aft fairing.
3. If the Seaglider is not listed, create a directory for the Seaglider (see "Commissioning a Seaglider on the basestation" on page 8). Otherwise, for more information, see"Checking the contents of Seaglider directory" on page 9.

Commissioning a Seaglider on the basestation

If using a hosted cloud basestation, contact Maritime support; otherwise follow these steps to create a directory on the basestation.

1. Type `su`, and then press Enter.

   NOTE: You must be logged in as super user (root) to create a directory.

2. When prompted, type the *password* for super user (i.e., super user (root)).

   The initial password is 1qazxsw2 (the number one, followed by qazxsw, and then the number 2).
3. Type `python /usr/local/basestation/Commission.py` *XXX* and then press Enter, where XXX is the serial number of the Seaglider being commissioned.
4. Type `ls`, and then press Enter.

   The new directory displays. If it does not, repeat step 3.
5. When finished, type `exit`, and then press Enter.

   NOTE: DO NOT stay logged in as root.

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Checking the contents of Seaglider directory

If the Seaglider directory is already present on the basestation (commissioning not needed), check the contents of the Seaglider directory on the basestation.

NOTE: Check the contents of the Seaglider directory at the start of every new set of testing and every mission.

1. Type `cd ~sgXXX`, and then press Enter.

   where XXX is the Seaglider serial number.
2. Type `ls`, and then press Enter. to check the directory's contents.
3. If there are any old data files (.cap, .eng, .log, .prm), move them to a new subdirectory with a descriptive name. For more information, see Chapter , "Moving data files" on page 9.

   The cmdfile, science, targets, .pagers, .urls and sg_calib_constants.m files should remain in the sgXXX home directory. For a description of the contents of the files, see Chapter 9, "Files for Operations" on page 171.

Moving data files

The program movedata.sh, that creates a subdirectory named by the user and moves older files from the top directory to that subdirectory, was installed at the factory.

1. Type `/usr/local/basestation/movedata.sh` (subdirectory name of your choice).

   NOTE: The name *basestation* depends on the version of basestation software that your system uses.
2. Press Enter.

Setting up a visualization site

If you have a visualization site for the Seaglider data, set up the communication and data transfer between the basestation and the visualization site. Edit the .url file on the basestation to send data to the visualization site. This set up is site/user specific. Your IT department can set it up.

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Setting up a Seaglider interface computer

The basestation interface computers are ones that pilots can use to connect to the basestation over the internet. Compared to the basestation, there is much more flexibility in how they are set up. Any OS is acceptable including Linux, Windows or Mac OS X. Any software that provides Secure Shell (SSH) and Secure File Transfer Protocol (SFTP) is acceptable as well.

NOTE: The program SSH (Secure Shell) is a secure replacement for telnet and the Berkeley r-utilities (rlogin, rsh, rcp, and rdist). It provides an encrypted channel for logging into another computer over a network, executing commands on a remote computer and moving files from one computer to another. SSH provides strong host-to-host and user authentication as well as secure encrypted communications over an insecure Internet.

iRobot usually uses Windows for the OS, PuTTY (open source) for the SSH client, and Windows Secure CoPy (WinSCP) as the SFTP client. However, there are dozens of programs that you can use on all three operating systems, so use whatever program you want. After loading the appropriate software on the interface computer, access the basestation using the SSH and SFTP clients. Your IT department provides the host name and password.

Setting up the field laptop

The Seaglider field laptop is the computer that connects directly to the Seaglider serial communications port. Like the basestation interface computer, there are many possible configurations. The Seaglider field laptop must have a serial port (or USB serial port adapter) and a serial terminal emulation program. iRobot uses the following:

- Operating system (OS): Windows
- Serial terminal emulation program: Tera Term Pro, latest released version (free software terminal emulator)

Configure the latest released version of Tera Term Pro for 9600, 8, N, 1, no hardware handshake, echo off and <CR> only. VT100 is the terminal that is emulated.



CAUTION:
Do not use Windows Hyper Terminal, a serial terminal emulation program, under any circumstance. It does not function well with Seaglider.

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Assembling the Seaglider cradle

NOTE: The configuration of the cradle may differ depending on what you ordered. If your configuration includes the Ogive-compatible cradle, use the second from the top and bottom screw holes for assembling the rails.

1. Make sure that you have all the parts shown in Figure 3-1 and the components listed in "Inspecting Seaglider system shipping container" on page 5.

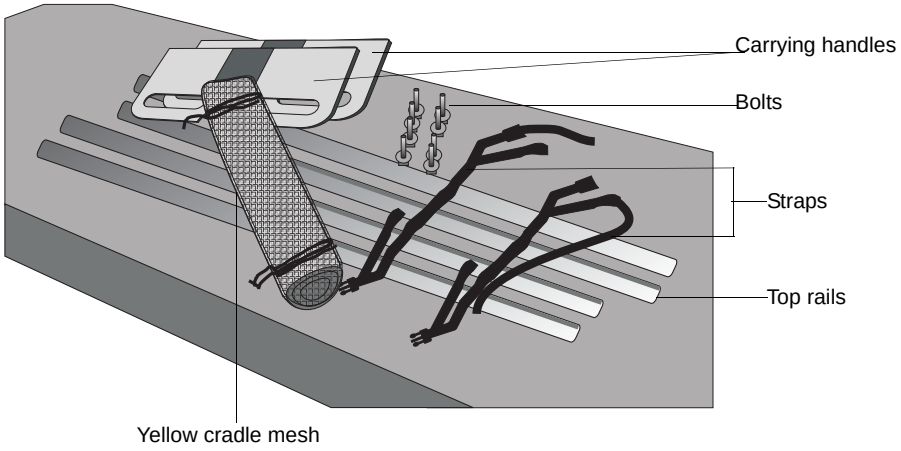


Figure 3-1. Launch and recovery cradle components

2. Insert two of the top rails through the side hems of the yellow mesh (one rail per side).

   NOTE: The four top rails are interchangeable.

3. Put a female strap on each end of one of the top rails and a male strap on each end of the other top rail.

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4. Attach the top rails to the carrying handles by sliding a lock washer and then a flat washer (in that order) onto the large bolt, and then inserting the bolt from the exterior side of the bolt hole in the handle into threaded hole in the rail (Figure 3-2).

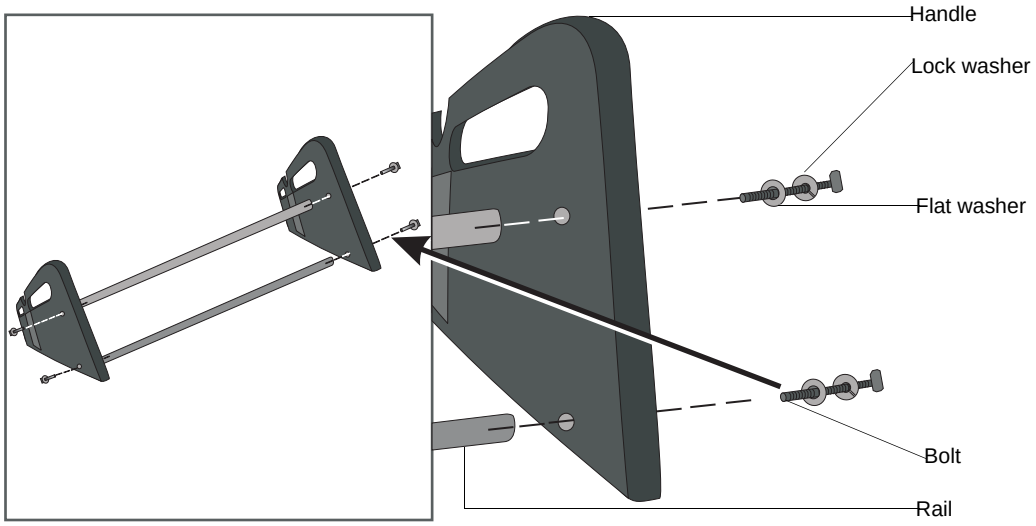


Figure 3-2. Cradle bolts, handle, and rail assembly

5. Give the bolts a couple of turns, but do not tighten yet.
6. Attach the lower rails to the handles using the same bolt/lock washer/flat washer combination as for the upper rails.
7. Tighten all four rails to the handles using a 3/4" wrench (not provided).
8. From the inside of the carry handles, insert the four eye bolts into the small holes on the carrying handles and secure with the wing nuts.
9. Thread the free ends of the strings attached to the mesh through their respective eye bolt and knot in place.

   The strings should be tight enough to keep the mesh from sliding more than a couple of inches in either direction, but the mesh should not be taut.

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Figure 3-3 shows the assembled cradle.

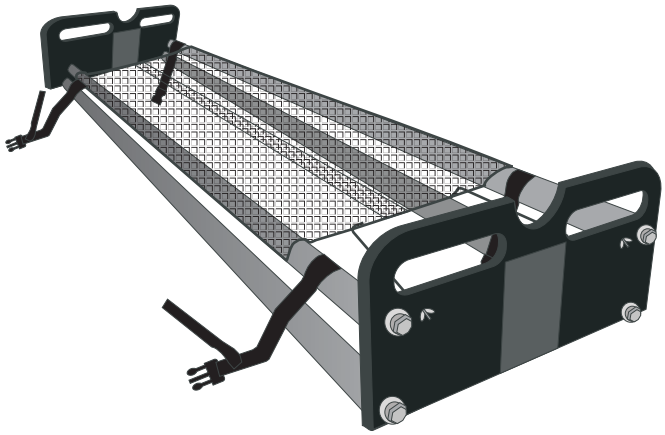


Figure 3-3. Assembled cradle

NOTE: Your cradle may differ, depending on whether you ordered a standard or Ogive glider.

10. Put the assembled cradle on the floor next to the shipping case.

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Assembling the Seaglider

NOTE: The configuration of your Seaglider system may differ, depending on what you ordered.

1. Remove Seaglider from the shipping case (a two person task) and place in the launch and recovery cradle with the tail of the aft fairing resting on one handle (Figure 3-4).

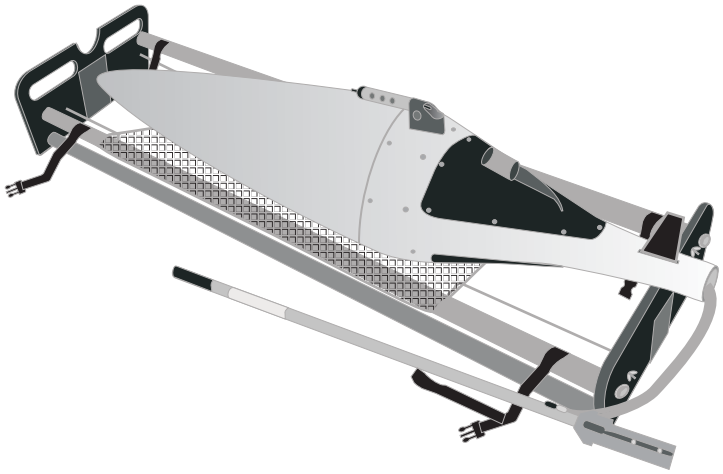


Figure 3-4. Position of Seaglider in the cradle

2. Remove the wings from case.

   Each wing is marked on the base of the root with the position where it should be secured, port or starboard side of the Seaglider, with the iRobot logo facing up and forward (see Figure 3-6 on page 18).

3. Install the port wing by inserting (8) 8-32 x 1/2" screws through the port wing and into the portside aft fairing holes.

   Start with the top screws, keeping them loose until all screws are started, and then tighten all of the screws until hand tight.

   NOTE: DO NOT over tighten the screws. Rotate Seaglider slightly to attach the lower screws.

4. Install the starboard wing by inserting (8) 8-32 x 1/2" screws through the starboard wing and into the starboard side aft fairing holes.

   Start with the top screws, keeping them loose until all screws are started, and then tighten all of the screws until hand tight.

   NOTE: DO NOT over tighten the screws. Rotate Seaglider slightly to attach the lower screws.

5. Check the wing orientation.

   The wings are correctly installed if the aft edges form a straight line across the fairing that is perpendicular to the axis of the Seaglider (see Figure 3-6 on page 18).

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6. In preparation for installing the antenna and rudder, slide Seaglider back in the cradle so that the slot in the rear of the aft fairing is outside of the cradle (Figure 3-4).

CAUTION:
If you ever need to disconnect the antenna cable from the aft endcap, make sure when reattaching the cable to the endcap, that the O-ring is present inside the cable end of the antenna. If the O-ring is not present, find the spare O-ring in the plastic spares kit, lubricate it with silicon grease, such as DC4, and install. The O-ring is critical for a watertight seal. Failure to install the O-ring properly can result in loss of Seaglider.

7. Remove the screws from the black hatch cover on the top of the aft fairing and take off the hatch cover to expose the antenna and communication cables and the bulkhead connectors on the aft endcap and check the tightness of the connectors. Put the hatch cover and the screws in a secure place near Seaglider.

   Figure 3-5 and Table 3-1 show the location of the bulkhead connectors on the aft endcap and the allowable sensors for each port.

   NOTE: Seaglider is shipped from iRobot with the antenna and serial cables attached. The serial connections should be hand tight. To tighten the antenna, use a 3/4-inch wrench to hold the DGO connector while tightening it.

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CAUTION:
Be sure to tighten serial connections prior to deployment. The serial connections should be hand tight. DO NOT over tighten. Over-tightening serial connections can cause water leakage, connectivity and communications issues.

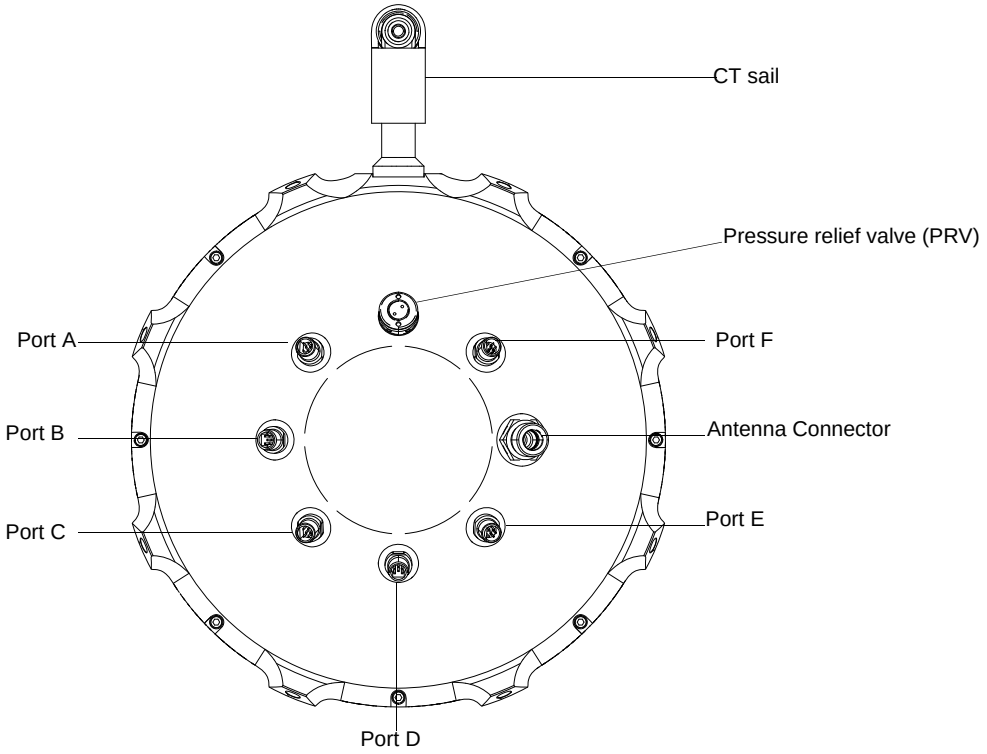


Figure 3-5. Sensor port locations on aft endcap

Table 3-1. Port locations and allowed sensors on aft endcap

Port	Sensors
A	COMMS
B	PAR
	WET Labs
	Aanderaa DO
	GPCTD
C	PAR
	WET Labs
	Aanderaa DO
	GPCTD
D	Free Flow Sea-Bird DO

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Table 3-1. Port locations and allowed sensors on aft endcap

Port	Sensors
E	ADCP (24V)
	Echosounder (24V)
	Aanderaa DO
	GPCTD
	PAR
	WET Labs
F	ADCP (24V)
	Echosounder (24V)
	Aanderaa DO
	GPCTD
	PAR
	WET Labs

NOTE: If E and F ports are configured for 24V, plugging any sensor other than the Echosounder sensor or ADCP sensor into these ports will damage the sensor. If iRobot installed an ADCP or Echosounder sensor, ports E and F will be configured for 24V.

8. Remove the rudder from the packing case and (2) ¼-20 screws from the spares kit and put in a secure place near Seaglider.
9. Slide the antenna mast/rudder boot into the back end of the aft fairing, orienting the round side of the boot away from the countersunk holes in the fairing. As the antenna mast is lowered into the fairing, reach through the hatch opening and guide the antenna and serial communication cables around the bladder and sensor cables.
10. When the antenna mast is in place, insert the rudder (sweeping toward the rear of Seaglider, notches toward the wings) through the slit just forward of the back end of the aft fairing, making sure that the antenna and serial communication cables are not in the way.
11. Do the following:
    a. Insert (2) 1/4 x 20, 2" screws through the countersunk holes in the fairing and into the threads in the rudder base.
    b. Double check the position of the antenna cables and rearrange if they are in the way of the rudder or screws.
12. Tighten the screws to hand tight.
13. Arrange the antenna and sensor cables in the area normally covered by the black hatch cover so that they do not impede the operation of the external bladder.
14. Replace the black hatch cover, starting all the screws before tightening them down to hand tight.

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15. Slide Seaglider forward in the cradle until the nose is touching the front of the cradle (Figure 3-6).

    The configuration of your Seaglider system may differ, depending on what you ordered.

    NOTE: The cradle is the same on both ends. The front and back of the cradle are determined by the position of Seaglider in the cradle.

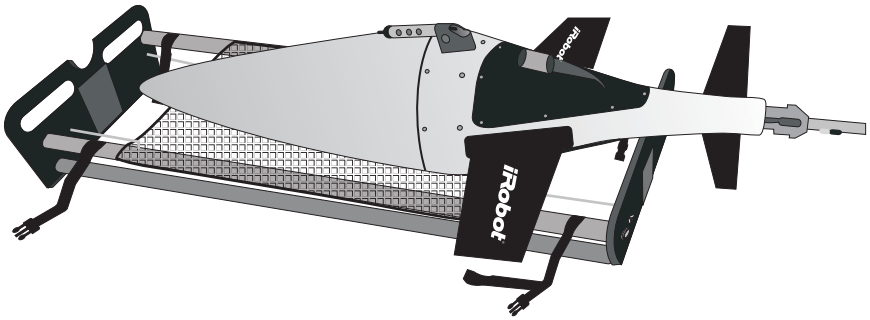


Figure 3-6. Fully assembled Seaglider

16. Connect the nylon straps and tighten to secure Seaglider in the cradle.
17. To store or move Seaglider in its cradle, the antenna mast should be detached from the aft fairing as in the following steps.
    a. Remove the rudder screws.
    b. Slide the antenna mast and rudder boot out of the aft fairing (can best be facilitated if the rudder section is outside of the cradle (Figure 3-6).
    c. Fold the antenna mast next to the Seaglider.
    d. Seaglider should look like the one in Figure 3-7.

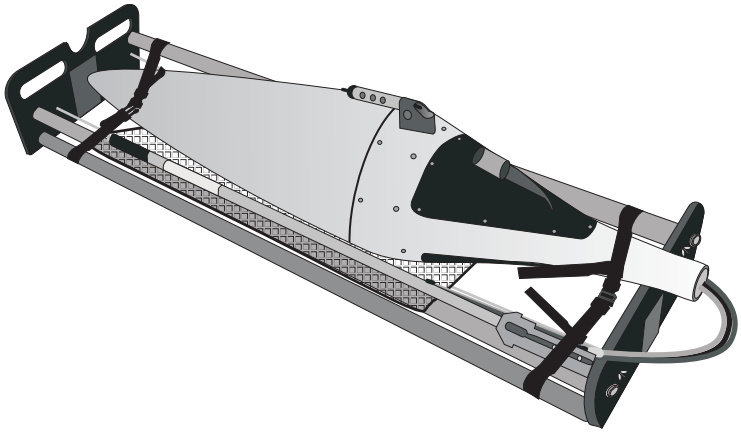


Figure 3-7. Seaglider with antenna mast removed from the aft fairing

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Stowing/moving Seaglider

See “Transporting Seaglider to the field” on page 117.

Checking out the Seaglider system

Now that all of the pieces of the Seaglider system have been set up (the Seaglider, basestation, basestation interface computer and the field laptop), it is time to start testing them together. Hardware checkouts are done to make sure Seaglider is functional after any work is done on Seaglider, after shipping and before going into the field. The end to end checkout tests Seaglider and the communications between Seaglider and the basestation.

Checking Seaglider communication with the field laptop

This test can be done in the lab.

1. For this test, the antenna mast may be bolted into position as it would be for deployment (Figure 3-1) or folded next to the Seaglider (Figure 3-8).

   The configuration of your Seaglider system may differ, depending on what you ordered.

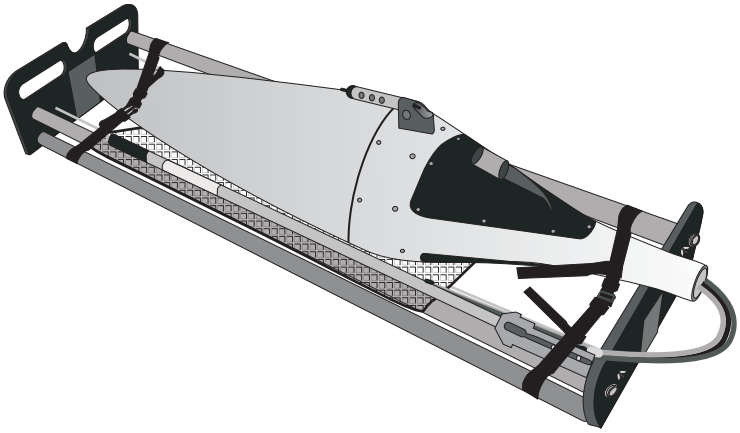


Figure 3-8. Antenna in stowed position

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2. Do the following to connect Seaglider to the laptop via the supplied non-powered serial communication cable:
   - Connect the 6-pin IE55 end of the cable to the communication port located at the base of the Seaglider antenna mast (Figure 3-9).

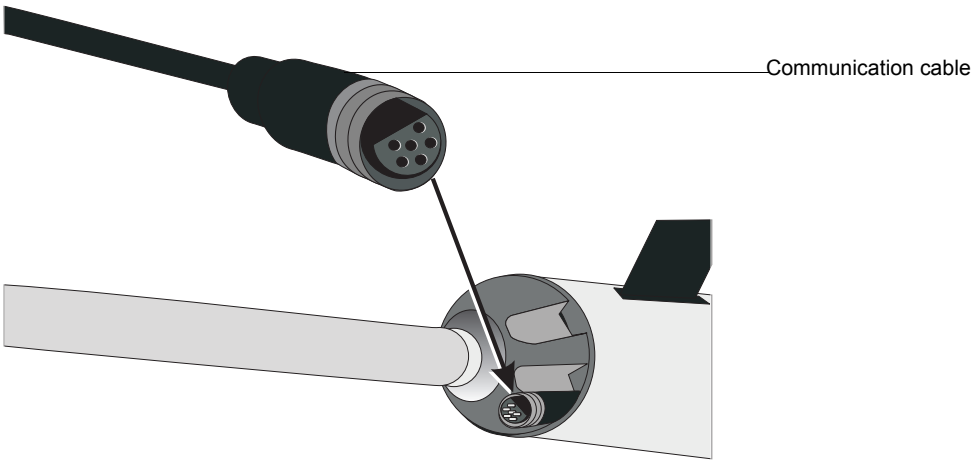


Figure 3-9. Connect the cable to the antenna mast

   - Connect the DB9 end of the cable to the laptop serial port (Figure 3-10). If the laptop does not have a serial port, use a USB to serial adaptor cable to make the connection between the serial communication cable and the laptop.

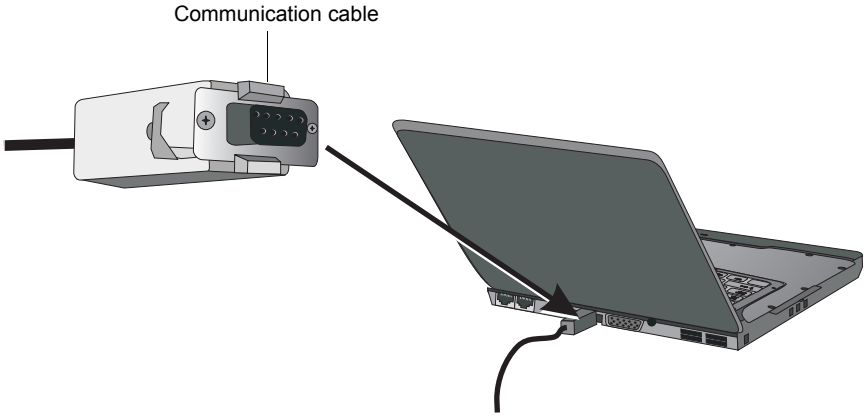


Figure 3-10. Connecting the cable to the laptop

3. Turn on the laptop and start the terminal emulation program.

   The port settings for the emulation program are 9600, 8, N, 1, no hardware handshake, local echo off and Enter to <CR>.

4. Turn on the screen capture on the laptop, if it is not already on.

   The method to do this varies with the terminal emulation program used.

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5. Take one of the magnetic wands from the shipping case (Figure 3-11).

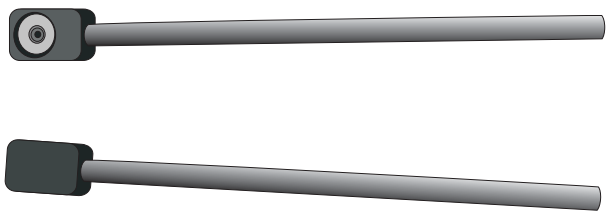


Figure 3-11. Seaglider magnetic wand

CAUTION:
Do not attempt to turn the glider ON or OFF using two magnetic wands together. This may adversely affect the compass calibration.

6. Slowly move the magnetic wand over the ON symbol on the starboard side of Seaglider, 20" aft of the nose, for at least 1 second to turn Seaglider on.

CAUTION:
Ensure that you keep the wand within 3 inches of the ON/OFF marking. Moving the magnetic wand further forward can interfere with the compass calibration.

7. Make sure that the wand is touching the fairing while moving it over the ON symbol (Figure 3-12). Several seconds after being turned on, Seaglider responds by sending lines of output to the laptop screen. If you do not see any output on the laptop screen, move the wand slowly around the mark, making a slight outward spiral, until you do.

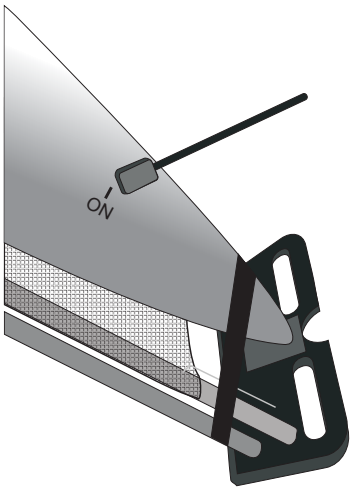


Figure 3-12. Move wand on, on starboard side

NOTE: Hold the wand on the starboard side to turn Seaglider on, and on the port side to turn Seaglider off. Use the mnemonic “Right ON!” to remember which side is On and Off.

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8. Within one minute of seeing output on the screen, press Enter.
9. In response to the date and time query, set the current date and time.

   Any setting within ~12 hrs. of the correct time is acceptable, because Seaglider gets an accurate time from its first GPS fix and resets the internal clock.

   NOTE: The format for setting the date and time is: **mm/dd/yyyy hh:mm:ss** with no missing values.
10. When prompted, "Are you running on external (bench) power?," do one of the following:
    - If you are running on internal Seaglider power, press Enter to accept the default answer (`N` for No).
    - If you are running on external bench power, type `Y` (for Yes) and press Enter.

    The Main Menu with five numbered items displays (Figure 3-13).


Version 66.07/18:775 starting up Mar 29 2011 10:36:24
Seaglider operating software developed and maintained by
Applied Physics Laboratory, University of Washington
Copyright 2003-2010, University of Washington
Built with SCENARIO, without ICE, without RAFOS, without KERMIT,
without ARS, without MMODEM, without PAAM, without AQUADOPP, without SAILCT,
without DEEPGLIDER, without HEAP RECYCLE, with REV_C, without LUA
with serial and logger device sensor integration facilities
developed by Integrative Observational Platforms Group, APL-UW
_mtop = 0x2fefff, _mbot = 0x28cdb8, _mcur = 0x28e000
glmalloc_init: glmalloc_data_init = 0x0
glmalloc_init: avail_bytes = 434175, requested_bytes = 358400
glmalloc_init: Allocated 358400 bytes.
2.386,SSENSOR,N,reading cnf gpctddo.cnf
2.735,SSENSOR,N,assigned WL_BBFL2VMT to sensor slot 1 (p = 83)
2.907,SSENSOR,N,assigned GPCTD to logger sensor slot 1 (p = 85)
3.911,SPOWER,N,Iridium_during_init saved current=0.10300
4.089,SPOWER,N,Iridium_during_connect saved current=0.16000
4.252,SPOWER,N,Iridium_during_xfer saved current=0.22300
4.421,SPOWER,N,GPS saved current=0.02696
4.569,SPOWER,N,TT8 saved current=0.01496
4.716,SPOWER,N,TT8_Active saved current=0.01421
4.873,SPOWER,N,TT8_Sampling saved current=0.03743
5.031,SPOWER,N,TT8_CF8 saved current=0.04717
5.187,SPOWER,N,TT8_Kalman saved current=0.05915
5.347,SPOWER,N,Analog_circuits saved current=0.01200
5.511,SPOWER,N,Compass saved current=0.01573
5.712,HCOMPASS,N,Active compass is SP3003
5.875,SSYS,N,Changing capture file
5.967,SSENSOR,N,sensor SBE_CT not found in installed sensors!
6.092,SSENSOR,N,sensor SailCTx not found in installed sensors!
6.212,SSENSOR,N,no CT sensor configured
9.538,SUSR,N,Glider 535, mission 0, dive 3, booted Thu Jan 1 00:00:09 1970
, boot #16
10.603,HXFDR,N,max range = 60.000000 m, timeout = 80 ms
10.901,SSURF,N,Hit CR within 1 minute to start, otherwise will go to recovery ...
Set current date and time
<CR> for default [03/29/2011 10:36:24]
Are you running on external (bench) power? [N]
------ Main Menu ------
1 [param] Parameters and configuration
2 [hw] Hardware tests and monitoring
3 [modes] Test operation modes and files
4 [pdos] PicoDOS commands (and exit)
5 [launch] Pre-launch
Enter selection (1-5,CR): 2

Figure 3-13. Seaglider set date, time, and power source

Checking the primary and alternate phone numbers

Check the primary and alternate telephone numbers that Seaglider calls to connect to the basestation.

1. Type **1**, **Parameters and Configuration**, and then press Enter.
2. Type **7**, and then press Enter.
3. If the primary telephone number is absent or incorrect, enter the primary basestation telephone number (Figure 3-14).

   The phone number includes the country code, area code, exchange and number.

   For example: In the US, the country code is 1. If the primary number of the basestation in the United States is (919) 123-4567, input 19191234567 into Seaglider.

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In the UK, the country code is 44. For example, if the telephone number of the basestation is (020) 1234 5678, input 4402012345678 into Seaglider.

NOTE: DO NOT include 00 at the beginning of the phone number to signify an international call. Seaglider adds this automatically.

```
------ Main Menu ------
     1 [param    ]  Parameters and configuration
     2 [hw       ]  Hardware tests and monitoring
     3 [modes    ]  Test operation modes and files
     4 [pdos     ]  PicoDOS commands (and exit)
     5 [launch   ]  Pre-launch
Enter selection (1-5,CR): 1 ——Step 1

------ Edit parameters ------
*Flight control and mission definition
     1 [basic    ]  Basic mission and glider parameters
     2 [dive     ]  Dive parameters
     3 [flight   ]  Flight parameters
     4 [surface  ]  Surface parameters
     5 [rafos    ]  RAFOS parameters
     6 [password]   Set/show glider login password
     7 [telnum   ]  Set/show basestation phone number
     8 [altnum   ]  Set/show basestation alternate phone number
*Pitch, roll, VBD
     9 [pitch    ]  Pitch parameters
    10 [roll     ]  Roll parameters
    11 [vbd      ]  VBD parameters
*Sensors and peripherals
    12 [config   ]  Hardware configuration parameters
    13 [pressure]   Pressure (external) parameters
    14 [intpress]   Pressure (internal) parameters
    15 [compass ]   Compass paramaters
    16 [altim    ]  Altimetry parameters
    17 [seabird ]   Seabird CT calibration
    18 [power    ]  Power parameters
*Utility
    19 [all      ]  Edit all parameters
    20 [validate]   Validate parameters
    21 [details ]   Show parameter details
    22 [show     ]  Show changed parameters
    23 [clear    ]  Clear changed parameters
    24 [save     ]  Save parameters by name to file
    25 [dump     ]  Dump parameters to screen
    26 [load     ]  Load parameters from file
    27 [reset    ]  Reset to defaults
    CR)  Return to previous
Enter selection (1-27,CR): 7 —— Step 2
6561.080,SUSR,N,Current telnum is 12062215341 ——Step 3
New telnum (15 char max length, CR to leave unchanged): 19194841429
6605.038,SUSR,N,Changing telnum to 19194841429
```

Figure 3-14. Verify primary telephone number

4. Type **8**, and then press Enter (Figure 3-15).
5. If the alternate telephone number is absent or incorrect, do the following:
   - Enter the alternate basestation telephone number, if available.

     The method is the same as that for the primary telephone number. If no alternate telephone number is available, leave the entry blank.

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- After you have entered the last telephone number, press Enter twice to exit to the Main menu (Figure 3-15).

```
------ Edit parameters ------
*Flight control and mission definition
     1 [basic    ]  Basic mission and glider parameters
     2 [dive     ]  Dive parameters
     3 [flight   ]  Flight parameters
     4 [surface  ]  Surface parameters
     5 [rafos    ]  RAFOS parameters
     6 [password]   Set/show glider login password
     7 [telnum   ]  Set/show basestation phone number
     8 [altnum   ]  Set/show basestation alternate phone number
*Pitch, roll, VBD
     9 [pitch    ]  Pitch parameters
    10 [roll     ]  Roll parameters
    11 [vbd      ]  VBD parameters
*Sensors and peripherals
    12 [config   ]  Hardware configuration parameters
    13 [pressure]   Pressure (external) parameters
    14 [intpress]   Pressure (internal) parameters
    15 [compass ]   Compass paramaters
    16 [altim    ]  Altimetry parameters
    17 [seabird ]   Seabird CT calibration
    18 [power    ]  Power parameters
*Utility
    19 [all      ]  Edit all parameters
    20 [validate]   Validate parameters
    21 [details ]   Show parameter details
    22 [show     ]  Show changed parameters
    23 [clear    ]  Clear changed parameters
    24 [save     ]  Save parameters by name to file
    25 [dump     ]  Dump parameters to screen
    26 [load     ]  Load parameters from file
    27 [reset    ]  Reset to defaults
    CR)  Return to previous
Enter selection (1-27,CR): 8
6699.777,SUSR,N,Current altnum is 12062217301
New altnum (15 char max length, CR to leave unchanged): 19193612847
6725.312,SUSR,N,Changing altnum to 19193612847
```

Figure 3-15. Verify alternate telephone number

For a complete listing of menu options available, when directly connected to Seaglider, and their function, see Appendix F, “Hardware and Configuration Menus” on page 279.

Checking the pump, motors, and basestation communication

Check the proper operation of the VBD pump, pitch and roll motors and Iridium communication with the basestation.

1. Disconnect the communication cable from the laptop and the Seaglider.
2. Move Seaglider outside to an area where you can position it with the antenna pointing up, with an unobstructed view of the sky.

   NOTE:

   - To make it easier to move the Seaglider outside, detach the antenna mast mount from the aft end (see “Checking out the Seaglider system” on page 19).
   - DO NOT disconnect the antenna cable for this procedure. Once outside, reinstall the antenna, if necessary, following the steps on page 15.
3. Connect the communication cable to Seaglider.

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4. Position Seaglider, in its cradle, nose down, antenna pointing up within 40° of vertical and make sure the antenna has an unobstructed view of the sky.

   NOTE: Secure Seaglider so that it cannot fall over.

5. Connect the communication cable to the laptop and power up the laptop.
6. Start the terminal emulation program and open a capture file.
7. Turn on Seaglider and set the date, time and power following steps 5-9 on page 21 through page 22.

   The Main menu with five numbered items displays (Figure 3-16).

```
------ Main Menu ------
     1 [param   ]  Parameters and configuration
     2 [hw      ]  Hardware tests and monitoring
     3 [modes   ]  Test operation modes and files
     4 [pdos    ]  PicoDOS commands (and exit)
     5 [launch  ]  Pre-launch
Enter selection (1-5,CR): 5

------ Launch Menu ------
     1 [scene   ]  Set scenario mode
     2 [selftest]  Perform interactive self test
     3 [autotest]  Perform autonomous self test
     4 [uploadst]  Upload self-test results
     5 [reset   ]  Reset dive/run number
     6 [test    ]  Test Launch!
     7 [sea     ]  Sea Launch!
    CR)  Return to previous
Enter selection (1-7,CR): 3
```

Figure 3-16. Prelaunch

8. Type **5**, **Pre-Launch**, and then press Enter (Figure 3-16).
9. Type **3**, **Perform Autonomous Self Test**, and then press Enter.

   For sample output from an autonomous self test, see Appendix E, “Autonomous Self Test” on page 269 for sample output from an autonomous self test. For information on the interactive self test, see “Interactive self test” on page 133 .

   NOTE: You do not have to do anything during the self test, but you should monitor the process on the laptop for any warnings or errors.

   An example of the files sent to the basestation via Iridium at the end of the self test as well as the output after the files are processed on the basestation are listed below. Carefully review the processed files for any warnings or errors.

   In the following example files (generated by Seaglider during a self test and sent to the basestation via Iridium), ‘st’ stands for self test and ‘0007’ means this is the seventh self test done on this Seaglider.

   st0007du.b.1a.x00

   st0007du.b.x00

   st0007du.r

   st0007du.x00

   st0007du.x00

   st0007du.x00

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st0007kz.r

st0007kz.x

The basestation processes the output files and produces the files listed below. The **pt** portion of the filename stands for processed test. The next three digits are the number of the Seaglider system, and 0007 is the number of the self test. For an explanation of each file, see "Seaglider generated files" on page 178.

pt5130007.cap

pt5130007.eng

pt5130007.log

10. Do one of the following:
    - If there are no warnings or errors in any of the files (expected outcome) the test is complete. Go to step 11.
    - If there is a problem during the testing, the final lines from the self test are: "Self test FAILED or ABORTED!"

      Review the self test to find the reason:
      - If there is a problem with the pitch, roll or VBD, contact iRobot customer service.
      - If there is a problem with the gps or with the Iridium connection or transfer of files over Iridium, reposition Seaglider by changing its location and/or its angle toward the sky, and then re-run the automated self test.
      - If , after several automated self test iterations, there are still errors with the gps, Iridium, or file transfer, contact iRobot customer service.
11. Turn off Seaglider by moving the magnetic wand over the OFF symbol on the port side of Seaglider 20" aft of the nose for at least 1 second while simultaneously pressing Enter (or have someone else press Enter) on the laptop keyboard. Continue moving the wand around the OFF symbol and pressing Enter until the laptop screen shows no response to pressing Enter.

    NOTE: Make sure that the wand is touching the fairing.

12. Disconnect the communication cable from Seaglider and the laptop and reinstall the dummy plug on Seaglider communication connector.
13. Detach the antenna mast from the aft fairing before storing or moving Seaglider in its cradle (see "Assembling the Seaglider" step 17 on page 18).

For information on stowing and moving Seaglider, see "Transporting Seaglider to the field" on page 117.

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CHAPTER 4

Operating Principles

Unlike an airplane, there are no moving external control surfaces on Seaglider. Figure 4-1 shows the primary components of Seaglider that control the movement of Seaglider through the water in a sawtooth pattern. The configuration of your Seaglider system may differ, depending on what you ordered.

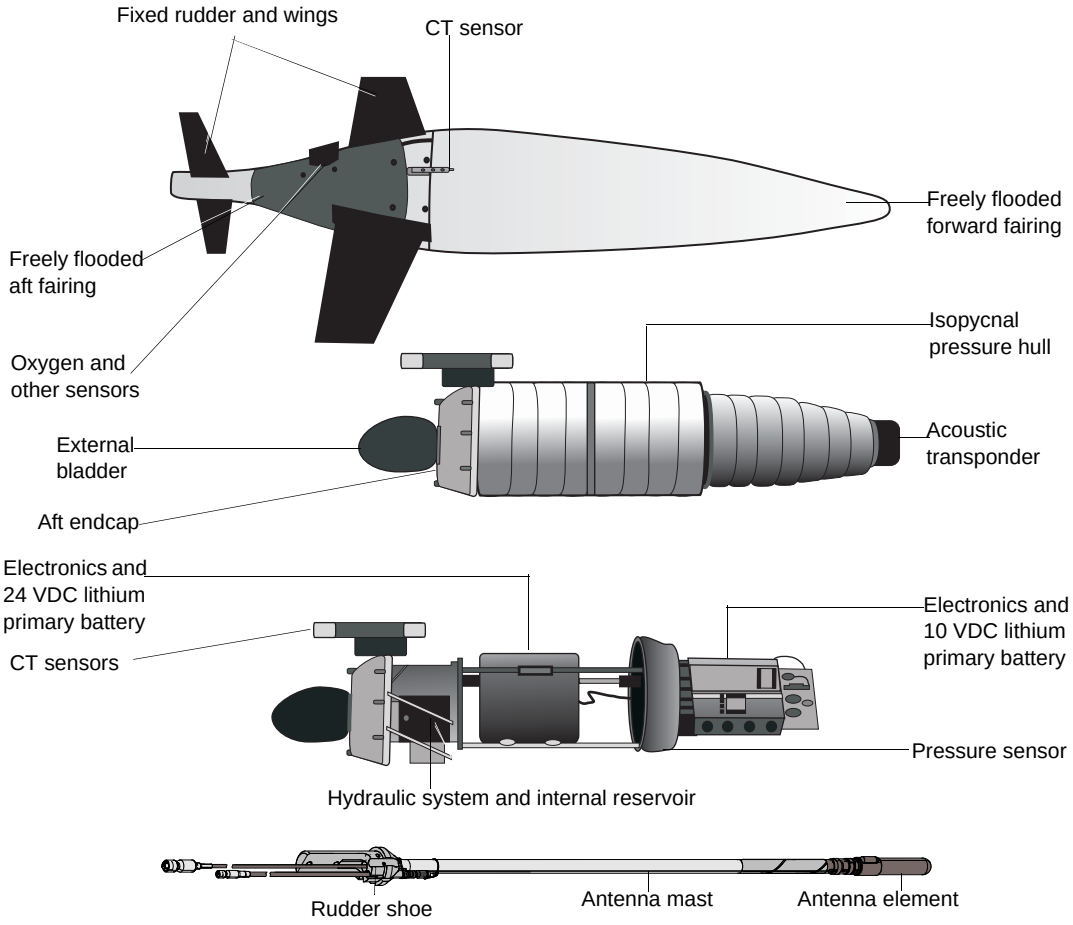


Figure 4-1. iRobot 1KA Seaglider and its primary components

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Seaglider components

Isopycnal pressure hull

An important and unique feature of Seaglider is the compressibility of its pressure hull. For maximum efficiency, Seaglider uses an isopycnal pressure hull, which is designed to have the same compressibility as seawater.

Other gliders have rigid pressure hulls that are designed to maintain a fixed volume at all rated pressures. As gliders with non-isopycnal hulls dive, any density increase in the surrounding water causes them to acquire positive buoyancy. This requires compensation (subtraction of displaced volume) to maintain a constant buoyancy difference. That same compensation has to be recovered by pumping to achieve positive buoyancy when Seaglider ascends.

The isopycnal hull of the Seaglider eliminates that need, as the pressure hull does not acquire positive buoyancy from the compression of the surrounding seawater. For dives to 1000 m, this results in about a 10% energy savings in the 24V energy budget.

Inside the pressure hull

The following components are located inside the isopycnal pressure hull:

- Mass shifter with the 24 VDC lithium primary battery
- Main electronics board assembly with the 10 VDC lithium primary battery attached underneath
- Internal components of the hydraulic system

CAUTION:
The components inside the pressure hull are user serviceable only by customers who successfully complete Refurbishment Training. Any unauthorized opening of the pressure hull voids the one year warranty (see Appendix K, “Standard Limited Warranty to Original Purchaser” on page 345).

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Mass shifter with 24 VDC battery pack

The 24 VDC lithium primary battery pack can be moved by the mass shifter mechanism forward and aft to control vehicle pitch (Figure 4-2) and side-to-side to control vehicle roll (Figure 4-3).

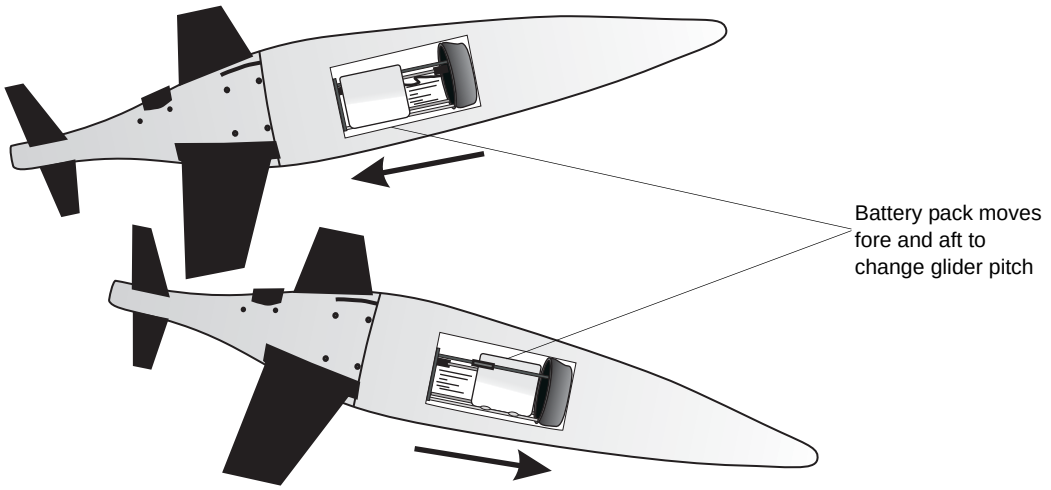


Figure 4-2. Mass shifter causing pitch change

Aside from providing the weight needed to change the pitch of the Seaglider system, the approximately 9000 g battery pack also powers pumps, motors, communications, and transponder.

A brass weight is attached to the bottom of the 24 VDC battery pack. This weight provides the axial asymmetry necessary to make the Seaglider system roll when the mass shifter is rolled to the port or starboard side (Figure 4-3).

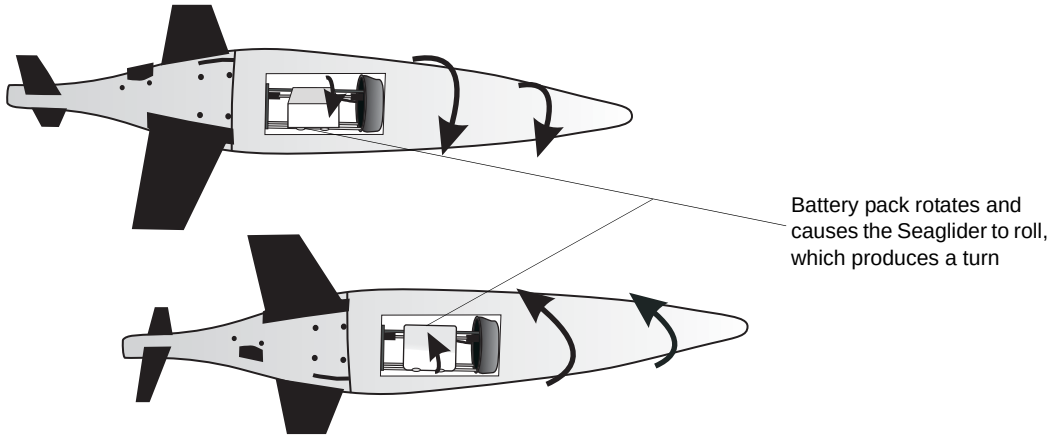


Figure 4-3. Mass shifter causing roll change

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Main electronics assembly with 10VDC battery pack

The microprocessors and electronics that control the flight (acoustic transponder, pitch, roll, buoyancy communications, GPS) and science sensors are located on the main electronics board on Seaglider. A 10 VDC lithium primary battery pack is installed underneath the electronics assembly. This battery, which weighs approximately 2600 g, powers the pressure and science sensors, processor, GPS, transponder, and main electronics.

Outside the pressure hull

The acoustic transponder, fairing, rudder, wings, antenna, and science sensors are located outside of the isopycnal pressure hull.

Acoustic transponder

The transponder, located on the front end of the pressure housing, is used for two separate functions:

- Seaglider location during recovery
- Altimetry during dives

External fairing

The outer shell, which includes the forward and aft fairings, allows Seaglider to move through the water smoothly, cutting down on drag and providing maximum energy efficiency.

Rudder and wings

The rudder and wings are fixed. The wings (with a combined span of 1 m) produce lift vectors, relative to CG (Center of Gravity) and CB (Center of Buoyancy), that turn Seaglider when rolled and cause the glider to move horizontally when net buoyancy is positive or negative and vehicle pitch is not past the stall angle. The rudder provides yaw stability as Seaglider moves forward.

Antenna mast

The antenna mast is attached to the aft end of Seaglider. It provides height to the antenna that is located at the top of the mast.

The antenna serves both the GPS and the Iridium modem:

- When Seaglider first surfaces, the antenna is switched to the GPS, allowing Seaglider to get a latitude/longitude position.
- The antenna is then switched to the Iridium modem, allowing Seaglider to:
  - Call the basestation
  - Upload data files, including its current position, to the basestation
  - Download new command, target, science, and pdos files from the basestation
- Once the communication session with the basestation is complete, the antenna is switched back to the GPS and a GPS fix is obtained before beginning the next dive.

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Science sensors

Seaglider comes standard with a Sea-Bird Electronics Conductivity and Temperature (CT) sensor. iRobot also has a growing list of optional sensors that they can install on Seaglider. At the time of this guide's publication (October 2012), the sensors included WET Labs ECO Pucks, Biospherical PAR, Aanderaa Optodes, SBE DO, SBE GPCTD, and Nortek AD2CP. For an up-to-date list of sensor options, see the Seaglider website at http://gisupport.irobot.com/cgi-bin/irobot_gi.cfg/php/enduser/acct_login.php.

Inside and outside the pressure hull

The Variable Buoyancy Device (VBD) is located both inside and outside of the isopycnal pressure hull. The VBD is a hydraulic system that achieves a specified total vehicle displacement by varying the size of an oil-filled bladder external to the pressure hull.

Effect on vehicle	Action of VBD
More buoyant	Pumps oil from a reservoir located inside the pressure hull into the bladder to increase the displacement of the vehicle
Less buoyant	Bleeds oil from the bladder back into the reservoir to decrease the vehicle’s displacement

For more information, see “Buoyancy” on page 33.

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Principles of Seaglider operation

There are a number of factors that affect how a Seaglider operates, including the water density and currents in the mission area and the static and dynamic forces acting on Seaglider. The following sections describe these factors, and how Seaglider is designed to deal with them.

Environmental factors

Density

Density is defined as mass per unit volume:

$$\rho = m/V$$

Oceanographers routinely switch between SI (mks) and cgs units when referring to seawater densities. Densities are specified in g/cm^3 (with a typical 1000 m ocean value of 1.0275 g/cm^3 relative to sea surface pressure) or kg/m^3 (with a typical 1000 m ocean value of 1027.5 kg/m^3 relative to sea surface pressure). Oceanographers have a shorthand notation for density, called σ, which is defined as:

$$\sigma = (\rho - 1000)\ kg/m^3$$

Thus, the typical 1000 m ocean water density in σ units is 27.5. In addition, we use the unit σ_T, which is defined as σ of a sample of water at a specific temperature and salinity (in situ) at standard atmospheric pressure. Densities discussed in Seaglider operations are typically given in cgs units (g/cm^3).

Stratification

Stratification is the term used to describe the density layering of the ocean, with denser water below lighter water (stable stratification). Strong stratification means a large change in density between two depths while weak stratification is a small change in density between two depths.

Currents

The depth-averaged current over the course of a dive influences the distance covered over the ground (DOG) by Seaglider. The depth-averaged aspect is important. Seaglider can make progress towards a waypoint even in the presence of strong adverse surface currents by diving through deeper waters with more favorable currents. The maximum depth-averaged current that Seaglider can stem is 40 cm/s, or 0.8 kts. These dives tend to be done with large negative thrust on the dive (-350 cc), and vertical velocities of 18 cm/s. The dives take about three hours between surfacing, or about eight dives per day in 1000 m of water.

It has been shown in deployments in the Kuroshio that the Seaglider system can make crossings of a strong western-boundary current. This is typically done in a triangular track, with an inshore and then an offshore transect of the strong current, followed by a return upstream in the calmer water offshore of the strong current.

One might imagine interesting tracks in the equatorial Pacific that would exploit the equatorial undercurrent. Sharp vertical shear in the currents can induce turning moments on the Seaglider body. Large vertical velocities (upwelling or downwelling) can introduce large changes in vertical velocity, and in some cases cause dives to truncate or abort prematurely.

For information on strategies for dealing with the environmental conditions, see Chapter 6, “Predeployment Tasks” on page 107.

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Static forces

Seaglider flight is controlled by systems that change buoyancy, pitch and roll. It is designed to operate within several hundred cubic centimeters (cc) of neutral buoyancy over a seawater density range of $10\sigma_T$.

- Buoyancy is controlled by changing the displaced volume of Seaglider.
- Pitch is controlled to put Seaglider in a nose up position for climbing, and a nose down position for diving and exposing the antenna at the surface. Pitch is controlled by altering the center of mass of the vehicle by moving the battery mass forward or aft.
- Roll is controlled to cause Seaglider to turn. Roll is changed by altering the center of mass of the vehicle by rotating the battery mass from side to side.

Gravity

Gravity is the force that pulls objects toward the center of the planet. The center of gravity of the Seaglider system is changed by the movement of the mass shifter inside Seaglider.

The mass shifter is moved forward and back to effect changes in the vehicle's pitch and from side to side to effect vehicle roll.

Seaglider achieves static trim by the addition of ballast weight between the fairing and the pressure hull. The position and amount of ballast is determined by mission and trim requirements. The addition or removal of science sensors also affects the required ballast weight.

Buoyancy

Buoyancy is the unbalanced (positive or negative) vertical force on a submerged object arising from the vertical pressure gradient. It was Archimedes who, as mentioned previously, stated that the buoyant (upward) force on a submerged object is equal to the weight of the fluid that is displaced by the object. The buoyancy of a submerged object is altered by changing its density, either by changing its mass or volume.

Submarines typically alter their buoyancy by changing their mass while maintaining their volume. Seaglider vehicles change their buoyancy by changing their displaced volume while keeping their total mass fixed. This is done by moving hydraulic oil between the reservoir inside the pressure hull and the bladder external to the pressure hull:

- Pumping oil from the internal reservoir to the external bladder increases the displaced volume, which increases the buoyancy of Seaglider.
- Bleeding oil from the external bladder into the reservoir decreases the displaced volume, which decreases the buoyancy of Seaglider.

Figure 4-4 shows the location of the external bladder.

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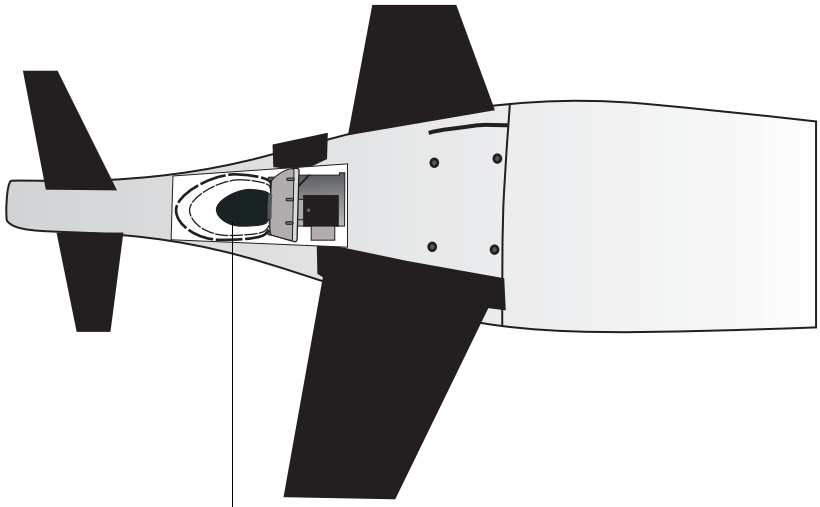


Figure 4-4. External bladder inflation and deflation

Dynamic forces

Lift

Seaglider gets lift from its body and wings, which convert the vertical force provided by the variable buoyancy device (VBD) into horizontal motion. Some additional lift comes from the rudder (vertical stabilizer) while banked (executing turns).

Drag

The shape of the hull was designed to maintain laminar flow over 70% of the hull length (between nose and CT sail) [Eriksen et al, 2001, Humphreys, Smith, et al., 2003]. Drag is partitioned into two types in the Seaglider flight model:

- Induced drag
- All other types of drag (for example, skin friction, form drag)

Drag is caused by anything projecting from Seaglider. Drag produced by sensor protrusion creates a large portion of total vehicle drag. The CT (Conductivity and Temperature) sensor on top, for example, causes approximately 30% of the vehicle's drag.

Drag is proportional to the square of speed, so reducing vehicle speed will increase the efficiency of thrust used relative to distance traveled.

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Hydrodynamic model

A hydrodynamic model for Seaglider is used by pilots to help with buoyancy trim and is used to evaluate depth-averaged currents.

The model has three parameters, traditionally called a, b, and c:

- Lift
- Drag
- Induced drag

For our purposes, it is convenient to think of the hydrodynamic model as a black box that produces estimates of the velocity of the Seaglider system as a function of computed buoyancy, observed pitch, and water density:

$$v_{model} = F(buoyancy_{computed}, pitch_{observed,} \text{ water density}).$$

The v_{model} can be resolved into horizontal and vertical components. In particular, the horizontal component, u_{model}, can be used with the observed compass headings throughout a dive to determine a dead-reckoned Seaglider track through the water. This results in a predicted surfacing position, based on the GPS determined dive starting point. The difference between this predicted surfacing position and the actual GPS determined surfacing position is what provides the estimate for depth-averaged current. Similarly, the vertical component, w_{model}, can be compared with $w_{observed} = dp/dt$, to adjust the VBD trim and then to estimate vertical velocities in the water column.

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Control of the static forces

During Seaglider operations, the pilot must monitor and control the vehicle pitch, roll, and buoyancy. Positions monitoring systems controlling these three things are encoded by linear potentiometers, digitized by 4096-count analog-to-digital (A/D) converters.

The A/D counts run from 0 to 4095. Physically attainable limits (also called hardware limits) for each system are determined empirically at the time of assembly. A safety margin is added to these physical limits to arrive at software limits, which are the positions (in A/D counts) beyond which the Seaglider operating software will not command that particular system.

Associated with each system are the following:

- A center position, which is intended to be the vehicle neutral for that system, in a particular environment.
- A factor that converts A/D counts to physical displacement, based on the mechanical design.
- A gain that relates movement of each system to the effect it has on the Seaglider.

Pitch

Pitch is controlled by moving the 24 V battery pack forward and aft along the longitudinal axis of Seaglider (Figure 4-3). The motion is accomplished by an electric motor, geared to drive a worm-gear in such a way that 319.92 A/D counts equals 1 cm of battery mass travel (**$PITCH_CNV**).

Seagliders typically respond to movement of the battery pack in the longitudinal axis by pitching 25-40° per centimeter of mass travel. This **$PITCH_GAIN** is a parameter, as it is dependent on the particular sensor suite and trim ballast installed on each Seaglider.

Table 4-1 shows some typical pitch ranges and values for Seaglider.

Table 4-1. Typical pitch ranges and values

	Hardware limit (A/D counts)	**Software limit (A/D counts)**
Full forward (nose down, -)	20	70 **($PITCH_MIN)**
Full aft (nose up, +)	3402	3352 (**$PITCH_MAX**)
$C_PITCH *(example)*		2346

Pitch movement (cm) = (Pitch Observed(counts)-**$C_PITCH**(counts)) x **$PITCH_CNV** (cm(counts))

Where:

$C_PITCH = pitch center position

$PITCH_CNV = pitch position conversion factor

While A/D counts are always positive, displacement can be positive or negative, relative to a given **$C_PITCH**. Pitch is usually trimmed so as to have 70% of the pitch travel available for pitching down (forward of **$C_PITCH**), and 30% available for pitching up (aft of **$C_PITCH**). This is to ensure a good surface position with Seaglider sufficiently pitched down to fully expose the antenna.

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Roll

Roll is controlled by rotating the 24V battery pack inside the hull. The pack is axially asymmetric and weighted (1100g brass weight) on its ventral face (as normally installed). An electric motor and gear train rotate the mass such that 35.37 A/D counts is equivalent to 1 degree of battery mass rotation (**$ROLL_CNV**).

Seagliders typically respond to the rotation of the battery pack by rolling 1/2º for every 1º of battery pack rotation. The response to the battery pack rotation is also dependent on the amount and distribution of trim lead.

The control strategy is to roll the 24V battery pack a specified amount (40º) in the appropriate direction when a turn is initiated, and then roll back to neutral (center) when the correct heading is reached. (Figure 4-3).

Setting **$ROLL_GAIN_P** greater than 0 will enable the proportional roll controller. This algorithm allows for smaller roll mechanism movements which yield lower power use and finer heading control. The following equation shows how **$ROLL_GAIN_P** is used by the proportional roll controller during a dive to figure out how much to move the roll mechanism.

Roll = (Desired Head - Actual Head) * **$ROLL_GAIN_P**

Clipped to +/- **$ROLL_DEG**

Typical values used for **$ROLL_GAIN_P** are 0.5 or 1.0.

NOTE: Seaglider turns in the opposite sense from its bank angle on the dive (opposite from upright airplane control), and in the same sense as its bank angle on the climb (same as upright airplane control).

Table 4-2 provides some typical roll ranges and values for Seaglider. Two roll centers, dive and climb, are used because asymmetries in Seaglider form (where components are installed inside Seaglider) result in different roll trim on dives and climbs.

Table 4-2. Typical roll ranges and values

	Hardware Limit (A/D counts)	**Software Limit (A/D counts)**
Full Roll to Port (-)	40–200	190–350 (**$ROLL_MIN**)
Full Roll to Starboard (+)	3900–4000	3750–3850 (**$ROLL_MAX**)
$C_ROLL_DIVE ***(example)***		2000
$C_ROLL_CLIMB ***(example)***		2050

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Buoyancy

Buoyancy is controlled by a mechanism called the Variable Buoyancy Device (VBD). It is a hydraulic system whose purpose is to maintain a specified total vehicle displacement by varying the size of an oil-filled bladder external to the pressure hull. The system pumps oil from an internal reservoir into the external bladder to increase displacement and allows oil to bleed from the external bladder into the internal reservoir to decrease displacement (Figure 4-4).

Linear potentiometers on either side of the internal reservoir measure the position of the reservoir's rolling diaphragm. The mean of the two values is reported as the position of the diaphragm, which can be interpreted as the amount of oil in the internal (or external) reservoir. The geometry of the system results in 4.0767 A/D counts per cm^3 of oil (**$VBD_CNV**). The point of neutral buoyancy is designated **$C_VBD**, and is set relative to the densest water to be encountered on a mission.

VBD control is calculated to achieve specific results, which depend on the pilot specified quantities:

- Seaglider vertical velocity
- Distance to next waypoint
- Maximum glide slope
- Rho (density)

VBD control is the "gas pedal" or throttle that controls vehicle horizontal velocity. Specific VBD control issues are discussed in more detail in Chapter 6, "Predeployment Tasks" on page 107.

Table 4-3 describes typical VBD ranges and values for Seaglider.

Table 4-3. Typical VBD Ranges and Values

	Hardware Limit (A/D counts)	Software Limit (A/D/count)	Volume (cm^3)
V_{max}	105	205 (**$VBD_MIN**)	557 (with respect to **$C_VBD**)
V_{min}	3610	3510 (**$VBD_MAX**)	-266 (with respect to **$C_VBD**)
Range			823
$C_VBD		2476	

NOTE: V_{max} is the maximum displaced volume of Seaglider, and V_{min} is the minimum displaced volume of Seaglider. When given in cm^3, they are with respect to a given **$C_VBD**.

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Features of control

Canonical dive

Seaglider performs its mission by repeating a canonical dive until either it is commanded to stop or until an abort condition is reached. Numerous aspects of the canonical dive are under the control of the pilot through an extensive set of parameters. A few are indicated in Figure 4-5. Many more are not shown, but explanations for them can be found in Chapter 5, “Piloting Parameters”.

The run phases of the dive are indicated by the intervals at the top of Figure 4-5 and the profile data boundaries are indicated by the interval at the bottom of the figure.

NOTE: Figure 4-5 is not to scale in either dimension.

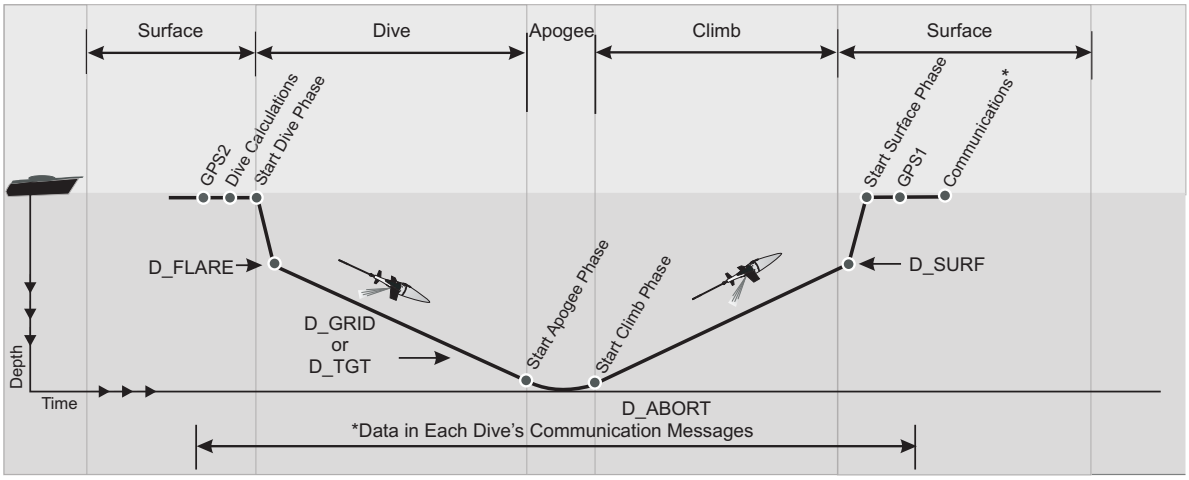


Figure 4-5. Canonical dive schematic

Control design

The Seaglider system’s flight control scheme has two guiding principles:

- Maintain constant vertical velocity during a dive
- Minimize the total energy expenditure during a dive

Constant vertical velocity is desired because Seaglider samples its sensors evenly in time. Constant vertical velocity then implies that the samples are equally spaced in depth.

The desired vertical velocity is not specified directly by a parameter, but is calculated from parameters that describe:

- Target depth of a dive (**$D_TGT**), in meters
- Time to complete a dive (**$T_DIVE**) from surface to surface, discounting pumping time at the bottom of the dive, in minutes

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Therefore, the desired vertical velocity, in cm/sec, is:

w_d = (2 * **$D_TGT** * 100cm/m)/(**$T_DIVE** * 60s/min)

Seaglider operating software chooses the buoyancy and pitch used on any individual dive to achieve the best results on that dive. The choices are bounded by the parameters:

- **$MAX_BUOY**: the maximum negative buoyancy allowed on a dive
- **$GLIDE_SLOPE**: the maximum glide slope allowed on the dive

The choices are also bounded by physical limits, neutral buoyancy (need some negative buoyancy to glide) and the stall angle. The software has to choose a buoyancy value between 0 (neutral) and **$MAX_BUOY**, and a desired pitch angle between the stall angle and **$GLIDE_SLOPE**.

The choice is determined by the distance to the next waypoint. The pitch angle is chosen to achieve the desired horizontal distance: maximum pitch if the waypoint is close, minimum pitch if the waypoint is distant, or the exact distance, if possible. Once the pitch angle is chosen, the buoyancy is chosen to achieve the desired vertical velocity in the densest (deepest) water.

The main energy draw on Seaglider is pumping hydraulic oil from the internal reservoir to the external bladder at depth, where the pump has to overcome the seawater pressure acting on the bladder. Since the pump can consume as much as 70% of the energy budget of Seaglider, control during flight is generally designed to minimize the total amount of pumping required on a dive. In particular, no additional bleeding post initial bleed is allowed on descent (dive) to maintain the vertical velocity. Pumping as necessary is allowed on the climb to maintain the vertical velocity.

Pitch is essentially steady during each phase of the operation, with the exception of slight pitch maneuvers on the climb to compensate for the changes in mass distribution and buoyancy due to pumping oil from the internal reservoir into the bladder. For detailed information on the control scheme, see “Run phases” on page 41.

Seaglider can cover up to 20 km/day through the water and can station-keep within a factor of two of the dive depth (2 km horizontal distance on 1 km vertical distance dives, 200 m on 100 m dives). The navigation system on Seaglider is waypoint-based, not track-based meaning the system decides on the most efficient way to reach the next waypoint, but does not attempt to stay on a given track. Track-based navigation can be approximated by using more waypoints along a track.

Sensor interfaces and sampling

Seaglider supports two science sensor interfaces to allow a variety of sensors to be connected to the vehicle via the serial ports. The two interfaces, Ordinary Serial Interface (OSI) and Autonomous Logger Interface (ALI) are described in Chapter 6, “Predeployment Tasks” on page 107.

Examples of OSI sensors supported by iRobot are SBE CT, WET Labs Eco Pucks, Aanderaa Optode, SBE DO, Biospherical PAR.

Examples of ALI sensors supported by iRobot are SBE GPCTD, Nortek AD2CP.

Sensor sampling intervals for the OSI sensors are specified in the science file. The practical lower limit on sampling is 4 seconds if only the conductivity and temperature sensors are sampled; however, with additional sensors installed, 5 seconds is the lower limit. The science file also gives the ability to turn off OSI sensors, or only energize them every nth sample of other sensors, in a given depth range.

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The sensor sampling intervals for an ALI sensor are controlled by the configuration file for that sensor and are independent of the sampling intervals of any other installed ALI sensors.

Bathymetry

Seaglider can read a digitized bathymetry map to determine how deep to dive, or can rely on the on-board altimeter to find the bottom and initiate the apogee maneuver. Bathymetry maps show the sea floor terrain as contour lines with associated depths.

Seaglider is less efficient operating in shallow water and most efficient in deep (up to 1000 m) water. The practical shallow water limit is 50 m. It is hard to make progress toward a waypoint in water shallower than that, for several reasons:

- Turn radius
- Pump time
- Surface time
- Currents

The turning radius (a few tens of meters at typical 25 cm/s horizontal speeds) is such that a significant portion of a shallow-water dive can be spent turning onto the correct course.

The most efficient pressure for the pumps differs for a standard buoyancy engine (SBE) or an enhanced buoyancy engine (EBE). If an SBE is installed, both pumps run continuously at any depth, except at the surface. iRobot recommends using the boost pump at the surface to decrease the current draw. At 10 m or shallower, the boost pump pumps 1.9 to 2.5 cc/s. At a depth of greater than 10 m, the boost pump does not move any oil into the bladder, and both pumps are required with the flow rate of 1.1 cc/s.

An EBE has three operational modes: boost pump only, main pump only, and both pumps. Use the boost pump only at a depth of 120 m or shallower (up to 180 psi) with a flow rate of 1.9 to 2.5 cc/s. At a depth of more than 120 m, use the main pump mode only to save some battery power; this mode also has a flow rate of 1.1 cc/s. When running both pumps, the flow rate is 1.1 cc/s; when operating in this mode, the boost pump uses more power, and so decreases battery life.

Time on the surface can be a significant percentage of the dive time. If surface currents or winds are adverse, Seaglider can lose as much or more distance toward a waypoint while on the surface as it gains on the dive.

The operating guidelines are to operate in water deeper than 200 m on offshore (deepwater) missions, and to try to stay in water deeper than 75 m on coastal or estuarine missions. Seaglider is rated to 1000 m, but the maximum depth that should be used for deep dives (**$D_TGT**) is 990 m to allow for the apogee maneuver.

Run phases

Launch and recovery phases are performed at the beginning and end of the mission. Surface, dive, apogee, and climb phases are meant to be repeated sequentially, once per profile, until the end of the mission. During the surface phase, GPS positions are acquired, communication with the basestation is

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accomplished, and navigation calculations for the next dive are made. Depth, time and functional triggers exist to cause Seaglider to move from one phase to the next.

Data acquisition is done in the dive, apogee, and climb phases of an autonomous run. During each of these phases, it is possible for the data acquisition to be interrupted by other high priority glider functions, such as when the mass shifter moves to change the glider's attitude. Although other actions are performed during these phases, the data collection process is never interrupted. Another periodic action performed during the profile phases (dive, apogee and climb) is guidance and control (G&C). G&C operations occur at intervals defined in the science file and are done only when necessary.

The three G&C operations that can occur are:

- Pitch adjustment
- VBD adjustment
- Roll adjustment

When G&C operations occur, Seaglider is said to be in "active" guidance and control mode. When G&C corrections are not being made, Seaglider is said to be in "passive" G&C mode. These definitions of active and passive modes refer to G&C operations only. They do not apply to data acquisition intervals or activities. Seaglider is acquiring data during all profile phases, whether in active or passive G&C mode. In passive G&C mode, the processor enters a low-power sleep state between data acquisition points. Seaglider flies in the state specified in the previous active G&C mode.

Launch

The launch phase begins when the field operator has initiated the Sea Launch procedure and all launch dialogue has completed. For detailed information on the launch procedure, see Chapter 6, "Predeployment Tasks" on page 107. At launch, Seaglider is in its surface position (rolled to neutral, pitched fully forward and pumped to **$SM_CC** which is typically the maximum VBD for launch and enters a normal surface phase – acquiring GPS1 fix and initiating a communication session with the basestation via Iridium satellite.

Surface

The surface phase begins at the end of the climb phase data acquisition. During the surface phase the following steps occur.

1. Surface maneuver

   The surface position of Seaglider is pitched fully forward (to the software limit), rolled to neutral (**$C_ROLL_CLIMB**), and pumped to VBD = **$SM_CC**.

   If Seaglider surfaces with VBD > **$SM_CC**, no bleeding is done to force VBD = **$SM_CC**. There are several ways to enter the surface maneuver. Seaglider is in the surface position at launch, after normal completion of a dive (reached **$D_SURF**), in recovery phase, or after **$T_MISSION** minutes have elapsed from the start of the dive without achieving **$D_SURF** in climb phase.

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The first test in the surface phase is to check whether the depth of Seaglider is less than **$D_SURF**.

- If it is, Seaglider pitches fully forward and pumps to **$SM_CC**.
- If it is not, Seaglider first pumps VBD to its maximum value, and checks the depth again. If the depth is less than **$D_SURF**, Seaglider moves the pitch mass to its full forward position. This behavior is designed to try to get Seaglider to the surface in the event of a **$T_MISSION** timeout.

2. GPS1

   Once the surface position is attained, the GPS receiver is turned on, and left on, until a satisfactory position is acquired or until **$T_GPS** minutes have elapsed. This GPS position is called **$GPS1.** When this initial position is acquired, Seaglider waits an additional **$N_GPS** samples for a GPS position with an HDOP < 2.0 at which point acquisition stops and that position is accepted. If a fix with an acceptable HDOP is not received in **$N_GPS** samples, the last position is accepted and the size of HDOP is recorded in Seaglider log files.

3. Communications

   Wireless communication via Iridium satellite begins following acquisition (or time out) of **$GPS1**. Seaglider powers up the Iridium phone, waits a specified time for registration with the Iridium system, and then attempts a data call to the basestation.

   Once the connection is established, Seaglider logs into the basestation as a dial-up user, and uses a modified XMODEM protocol to transfer files. Data and log files are transferred from Seaglider to the basestation, and command, control, diagnostic and special purpose files are transferred from the basestation to Seaglider. See Chapter 9, “Files for Operations” on page 171.

   If all file transfers were not accomplished, Seaglider waits **$CALL_WAIT** seconds and tries again. It tries to call up to **$CALL_TRIES** times, and if unsuccessful, continues with the surface phase, marking files as appropriate for later transfer, and incrementing the **$N_NOCOMM** parameter.

4. Measure surface depth and angle

   After the communications session, Seaglider computes the average of 10 pressure readings, and then the average of 10 pitch angles to obtain a measurement of the surface position of the Seaglider system. These values are written into the log file for the next dive.

5. GPS2

   After the surface pressure and pitch angle averages are completed, a second GPS fix, **$GPS2**, is acquired. This fix is the most recent position of Seaglider prior to diving.

6. Navigation and flight calculations

   The final component of the surface phase is the calculation of the parameters to determine the flight path during the next profile: buoyancy, pitch angle and heading. These computations include the dive calculations and the digital bathymetry table lookup, if enabled. On completion of the calculations, the surface phase is finished and a new dive phase (and new profile) are started.

Dive phase

The dive phase begins on completion of the navigation and flight calculations that conclude the surface phase. Initially, pitch is in the full forward position and the VBD volume is equal to the endpoint of the surface maneuver. At the start of the dive phase, a VBD adjustment (bleed) is executed during the first guidance and control (G&C) operation to get Seaglider off the surface as quickly and with as much vertical velocity as possible. (Recall that pitch is still in the maximum forward position.) When

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Seaglider reaches a prescribed depth, **$D_FLARE**, it goes into a regular G&C operation (pitch, VBD, roll) to move to the desired pitch, VBD position, and course computed for the profile.

If the glider's speed is too fast on the dive section of the profile (too heavy), VBD pumping is not allowed to correct the speed error. The reasoning behind this energy conserving measure is two-fold. First, as Seaglider descends into denser water, it becomes less negatively buoyant and slows down. Second, if corrective pumping were allowed on the dive, it is possible that additional bleeding would be required to compensate as Seaglider reached denser water. That would then mean more pumping, and more energy expenditure, to eventually reach the buoyancy endpoint of the surface maneuver. Excess speed is tolerated on the dive to help minimize the total energy expenditure on the profile.

In the dive phase, Seaglider turns to starboard by banking to port and vice versa (opposite to upright aircraft flight).

Apogee

When the target depth is reached, Seaglider enters the apogee phase. The apogee phase is a two G&C cycle procedure to smoothly transition from the dive phase to the climb phase without stalling.

During the first G&C cycle of this phase, Seaglider is pitched to an intermediate angle, **$APOGEE_PITCH**, rolled to neutral, and the VBD is pumped to 0 cc. The course adjustment and passive G&C mode are skipped.

A second G&C cycle is then executed and Seaglider is first pitched, then VBD is pumped, both to the inverse positions of the dive (pitch = -pitch, VBD = -VBD).

Data sampling of OSI sensors continues throughout the apogee phase. Data sampling of the ALI sensors during apogee is sensor specific and dependent on the settings in the specific sensor's configuration file.

Climb

The climb phase begins at the completion of the second G&C cycle of the apogee phase. Seaglider is positively buoyant and pitched up, headed for the surface at the same target vertical rate as achieved on the dive phase of the profile.

As in the dive phase, data acquisition and G&C continue at the intervals specified in the science file (OSI sensors) or in the configuration file of the ALI sensor.

If Seaglider system's speed is too fast on the climb section of the profile (Seaglider is too light), VBD bleeding is NOT allowed to correct the speed error to conserve energy.

There are two reasons for this methodology. First, any oil that is bled needs to be pumped again during the surface maneuver using more energy. Second, as Seaglider climbs it enters less dense water, becoming less positively buoyant and slowing down.

VBD pumping operations are allowed in the case of Seaglider being too heavy and slowing down. The **$MAX_BUOY** restriction does not apply to the climb phase. This usually does not affect the amount of energy used during the profile very much because the oil would need to be pumped during the surface maneuver anyway.

In the climb phase, Seaglider turns to starboard by banking to starboard and vice versa (as in aircraft flight).

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When Seaglider reaches the depth **$D_SURF** it begins its approach to the surface. It computes how many more data samples to take, based on the observed vehicle vertical speed, depth and the data sample interval. The maximum number of data samples Seaglider may take from **$D_SURF** to the surface is 50. When the calculation is complete, Seaglider enters the passive G&C mode and collects the number of scientific data samples based on the above calculation. After this period of data acquisition, Seaglider enters the surface phase.

Recovery

The recovery phase is entered either by command of the pilot (when it is necessary or desirable to keep Seaglider at the surface) or by an error condition detected by the Seaglider system's operating software. In the recovery phase, Seaglider stays on the surface and acquires a series of GPS fixes which are sent to the basestation so that Seaglider can be recovered.

In recovery, Seaglider enters a loop of obtaining a GPS fix and communicating that position with the basestation every **$T_RSLEEP** minutes. In practice, there are about two minutes of overhead in this process, so that the actual time between phone calls is closer to **$T_RSLEEP** + 2 minutes. This recovery loop may be exited by sending a **$RESUME** directive to Seaglider via the cmdfile. Once the **$RESUME** directive is received by Seaglider, it will start diving again.

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CHAPTER 5

Piloting Parameters

Parameter conventions

All parameters have a leading **$** in their name. This guide uses boldface font to denote all parameters, and italic font for file names. Nominal values are given with most parameters and are not default values. Parameter values associated with a dive that are reported by Seaglider in the log file include all the pilot-changeable parameters described in this document. Also, the values generated on board the Seaglider – such as glide angle, pitch angle, and desired heading – are also given parameter-like names for consistent parsing during post-dive data processing.

Command file (cmdfile) state directives

Introduction

The command file (cmdfile) directives control the state of autonomous Seaglider operations (Table 5-1). The directives are given as the last (and perhaps only) line of the command file and are stored on the basestation and transferred to Seaglider during its communication session. Directives do not have associated values like other cmdfile parameters do.

Table 5-1. Directives

Directive	Definition
$GO	This command will cause Seaglider to continue in its current mode of operation. If in an autonomous run, doing repeated dives, it will continue to dive according to its current set of parameters. If a **$GO** command is received while Seaglider is in the recovery state, Seaglider will stay in the recovery state. If received while Seaglider is in the diving state it will continue in that state. Note that error conditions that occur during a dive may cause the operating code to change the state of Seaglider from diving to recovery.

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Table 5-1. Directives (Continued)

Directive	Definition
$RESUME	This command will cause Seaglider to resume diving from within the recovery phase, using its current set of parameters. If Seaglider is in dive state at the time the **$RESUME** command is received it will continue diving. If Seaglider is in recovery state at the time it receives a RESUME, it will start diving with existing parameters.
$QUIT	This command will cause Seaglider to go immediately to the recovery state. Seaglider will hold at the surface, sleeping **$T_RSLEEP** minutes between the end of one communication session and the start of the next. There are about two minutes of communication overhead associated with each session, so the sessions are approximately (**$T_RSLEEP** + **2**) minutes apart. Replacing the **$QUIT** directive with a **$RESUME** directive will cause Seaglider to initiate a new dive with the existing set of parameters.

Table 5-2 outlines the effect of each directive on Seaglider in each of the autonomous run states: diving and recovery.

Table 5-2. Effect of directive on dive or recovery state

	Directive		
State	**$GO**	**$RESUME**	**$QUIT**
Diving	Diving	Diving	Recovery
Recovery	Recovery	Diving	Recovery

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Piloting parameters

1KA Seaglider parameters are changeable by the pilot via the command file, using the convention **$NAME,value** (example: **$SM_CC,475**). There is no space between the comma and the value. In this section, each parameter is listed alphabetically, described and where appropriate nominal, minimum, and maximum values are given.

The "Parameters by category" section lists the parameters in order of frequency used.

Parameters by category

For complete details on the use of the parameters and how they interact with one another, see "Alphabetized parameters" on page 56.

Table 5-3. Parameters listed by category and frequency of modification

Modification frequency	Category	Parameter
Most frequent	Dive profile	**$D_TGT**,*meters*
		$D_ABORT,*meters*
		$T_DIVE,*minutes*
		$T_ABORT,*minutes*
		$T_MISSION,*minutes*
	Buoyancy limits	**$MAX_BUOY**,*cc*
	NOTE: Smaller values for these parameters save energy by reducing pumping during each dive.	**$SM_CC**,*cc*

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Table 5-3. Parameters listed by category and frequency of modification (Continued)

Modification frequency	Category	Parameter
Second most frequent	Flight behavior and improvement thereof	**$C_VBD**,*AD counts*
		$C_PITCH,*AD counts*
		$PITCH_GAIN,*degrees*/*cm*
		$C_ROLL_DIVE,*AD counts*
		$C_ROLL_CLIMB,*AD counts*
		$D_SURF,*meters*
		$GLIDE_SLOPE,*degrees*
		$D_BOOST,*meters*
		$T_BOOST,*seconds*
	Communications	**$T_RSLEEP**,*minutes*
		$CAPUPLOAD,*Boolean*
	Navigation	**$NAV_MODE**,*integer*
		$COURSE_BIAS,*degrees*
		$HEAD_ERRBAND,*degrees*
		$KALMAN_USE,*integer*
		$FERRY_MAX,*degrees*
		$HEADING,-1 or *degrees*
		$SPEED_FACTOR,*value - multiplier*
		$TGT_DEFAULT_LAT,*degrees decimal minutes*
		$TGT_DEFAULT_LON,*degrees decimal minutes*
	Bottom determination and altimetry	**$USE_BATHY**,*integer*
		$D_OFFGRID,*meters*
		$ALTIM_BOTTOM_PING_RANGE,0/off or *meters*
		$ALTIM_BOTTOM_TURN_MARGIN,0/off or *meters*
		$ALTIM_PING_DEPTH,0/off or *meters*
		$ALTIM_PING_DELTA,0/off or *meters*
	Dynamic flight feedback system	**$PITCH_ADJ_GAIN**,0/off or *cm/deg*
		$PITCH_ADJ_DBAND,0/off or *degrees*
		$ROLL_ADJ_GAIN,0/off or *deg*/*seconds*
		$ROLL_ADJ_DBAND,0/off or *degrees*
		$ROLL_GAIN_P,0/off, or *degrees roll per degree yaw error*

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Table 5-3. Parameters listed by category and frequency of modification (Continued)

Modification frequency	Category	Parameter
Less frequent	Flight behavior and improvement	**$D_FLARE**,*meters*
		$APOGEE_PITCH,*degrees*
		$ROLL_DEG,*degrees*
		$D_FINISH,*meters*
		$N_NOSURFACE,*integer*
		$T_LOITER,*seconds*
	Turn length and data sampling rate during turn	**$T_TURN**,*seconds*
		$T_TURN_SAMPINT,*seconds*
	Communications and files	**$CALL_TRIES**,*integer*
		$CALL_WAIT,*seconds*
		$N_FILEKB,*integer*
		$CALL_NDIVES,*integer*
		$UPLOAD_DIVES_MAX,*integer*
		$COMM_SEQ,*integer*
		$CAPMAXSIZE,*bytes*
		$GC_WINDOW,*dives*
		$N_GPS,*seconds*
		$T_GPS,*minutes*
	Bottom and top detection	**$ALTIM_TOP_PING_RANGE**,0/off or *meters*
		$ALTIM_TOP_TURN_MARGIN,0/off or *meters*
		$ALTIM_TOP_MIN_OBSTACLE,0/off or *meters*
		$ALTIM_FREQUENCY,*kHz*
		$ALTIM_PULSE,*milliseconds*
		$ALTIM_SENSITIVITY,*integer*
		$XPDR_VALID,*integer*
		$XPDR_INHIBIT,*1/10 seconds*
	Flight model and environment	**$HD_A**,*value*
		$HD_B,*value*
		$HD_C,*value*
		$RHO,*gm/cc*

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Table 5-3. Parameters listed by category and frequency of modification (Continued)

Modification frequency	Category	Parameter
Less frequent (Continued)	**CAUTION:** Use caution when changing these parameters.	
	Safety	**$N_NOCOMM**,*integer*
		$D_NO_BLEED,*meters*
		$T_NO_W,*seconds*
		$TGT_AUTO_DEFAULT,*Boolean*
		$PITCH_MAXERRORS,*integer*
		$ROLL_MAXERRORS,*integer*
		$VBD_MAXERRORS,*integer*
		$CF8_MAXERRORS,*integer*
		$UNCOM_BLEED,*AD counts*
		$RELAUNCH,*integer*
	Seaglider modified	**$DIVE**,*integer*
		$GC_LAST_COLLECTION,*dive number*
		$MISSION,*integer*
		$T_GPS_ALMANAC,*minutes*
		$T_GPS_CHARGE,*seconds*
		$R_PORT_OVSHOOT,*AD counts*
		$R_STBD_OVSHOOT,*AD counts*
During fabrication	**CAUTION:** Use caution when changing these parameters.	
	Advanced use	**$ID**,*integer*
		$MASS,*grams*
		$T_WATCHDOG,*minutes*
		$AH0_24V,*AmpHours*
		$AH0_10V,*AmpHours*
		$EBE_ENABLE,*Boolean*
		$FILEMGR,*integer*
		$PRESSURE_YINT,*value*
		$PRESSURE_SLOPE,*calibration value*
		$AD7714Ch0Gain,*value*
		$TCM_PITCH_OFFSET,*degrees*
		$TCM_ROLL_OFFSET,*degrees*

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Table 5-3. Parameters listed by category and frequency of modification (Continued)

Modification frequency	Category	Parameter
During fabrication (Continued)	Advanced use (Continued)	**$ROLL_MIN**,*AD counts*
		$ROLL_MAX,*AD counts*
		$ROLL_CNV,*AD counts*/*degree*
		$ROLL_TIMEOUT,*seconds*
		$ROLL_AD_RATE,*AD counts*/*second*
		$PITCH_MIN,*AD counts*
		$PITCH_MAX,*AD counts*
		$PITCH_DBAND,*cm*
		$PITCH_CNV,*AD counts*/*cm*
		$P_OVSHOOT,*cm*
		$PITCH_TIMEOUT,*seconds*
		$PITCH_AD_RATE,*AD counts*/*second*
		$VBD_MIN,*AD counts*
		$VBD_MAX,*AD counts*
		$VBD_DBAND,*cc*
		$VBD_CNV,*AD counts*/*cc*
		$VBD_TIMEOUT,*seconds*
		$PITCH_VBD_SHIFT,*cm travel* /*cc pumped*
		$VBD_PUMP_AD_RATE_SURFACE,*AD counts*/*second*
		$VBD_PUMP_AD_RATE_APOGEE,*AD counts*/*second*
		$VBD_BLEED_AD_RATE,*AD counts*/*second*)
		$HEAPDBG,*Boolean*
		$INT_PRESSURE_SLOPE,*calibration value*
		$INT_PRESSURE_YINT,*calibration value*

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Table 5-3. Parameters listed by category and frequency of modification (Continued)

Modification frequency	Category	Parameter
During fabrication (Continued)	Advanced use (Continued)	**$DEVICE1**,*integer*
		$DEVICE2,*integer*
		$DEVICE3,*integer*
		$DEVICE4,*integer*
		$DEVICE5,*integer*
		$DEVICE6,*integer*
		$COMPASS_USE,*integer*
		$COMPASS_DEVICE,*integer*
		$COMPASS2_DEVICE,*integer*
		$PHONE_DEVICE,*integer*
		$GPS_DEVICE,*integer*
		$XPDR_DEVICE,*integer*
		$SIM_W,off/0 or *cm/seconds*)
		$SIM_PITCH,off/0 or *degrees*)
		$SEABIRD_T_G,*calibration value*
		$SEABIRD_T_H,*calibration value*
		$SEABIRD_T_I,*calibration value*
		$SEABIRD_T_J,*calibration value*
		$SEABIRD_C_G,*calibration value*
		$SEABIRD_C_H,*calibration value*
		$SEABIRD_C_I,*calibration value*
		$SEABIRD_C_J,*calibration value*
		$MINV_10V,*voltage*
		$MINV_24V,*voltage*
		$LOGGERS,*integer*
		$LOGGERDEVICE1,*integer*
		$LOGGERDEVICE2,*integer*
		$LOGGERDEVICE3,*integer*
		$LOGGERDEVICE4,*integer*
		$CURRENT,*m/s,degrees,Boolean*)
		$MEM,*bytes*
		$FG_AHR_10V,*amp-hr*
		$FG_AHR_24V,*amp-hr*
		$FG_AHR_24Vo,*amp-hr*
		$FG_AHR_10Vo,*amp-hr*

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Table 5-3. Parameters listed by category and frequency of modification (Continued)

Modification frequency	Category	Parameter
During fabrication (Continued)	**CAUTION:** Use caution when changing these parameters.	
	Advanced GPCTD (Glider Payload Conductivity, Temperature, and Depth) parameters	**$PC_RECORDABOVE**,*meters*
		$PC_PROFILE,*integer*
		$PC_XMITPROFILE,*integer*
		$PC_UPLOADMAX,*bytes*
		$PC_STARTS,*integer*
		$PC_INTERVAL,*seconds*
		$PC_RECORDCONTINUOUS,*integer*
		$PC_RECORDAPOGEE,*integer*
	Advanced ADCP (Acoustic Doppler Current Profiler) parameters	**$CP_RECORDABOVE**,*meters*
		$CP_PROFILE,*integer*
		$CP_XMITPROFILE,*integer*
		$CP_STARTS,*integer*
		$CP_INTERVAL,*seconds*
		$CP_RECORDCONTINUOUS,*integer*
		$CP_RECORDAPOGEE,*integer*
	Advanced Echosounder parameters	**$ES_RECORDABOVE**,*meters*
		$ES_PROFILE,*integer*
		$ES_XMITPROFILE,*integer*
		$ES_UPLOADMAX,*bytes*
		$ES_STARTS,*integer*
		$ES_INTERVAL,*seconds*
		$ES_RECORDCONTINUOUS,*integer*
		$ES_RECORDAPOGEE,*integer*

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Alphabetized parameters

Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$AD7714Ch0Gain Set by manufacturer. Do not change.	The gain assigned to the pressure sensor channel on the AD7714 analog-to-digital converter. The parameter takes two values: 128 for normal Seaglider operations with the installed Paine pressure sensor, and 1 for bench testing where a synthetic voltage is injected in place of the pressure sensor output to simulate diving. If the parameters **$SIM_W** and **$SIM_PITCH** are non-zero, this parameter does not apply.	128		
$AH0_10V Set by manufacturer. Do not change.	The capacity of the 10V (low voltage) battery pack (AmpHr). There is a small safety factor in this number, and its accuracy has been verified in post-recovery depletion testing of Seaglider battery packs. Seaglider goes into the recovery state if the total 10V battery pack amp-hours used on a mission equals or exceeds this value.	95	1	100
$AH0_24V Set by manufacturer. Do not change.	The capacity of the 24V (high voltage) battery pack (AmpHr). There is a small safety factor in this number, and its accuracy has been verified in post-recovery depletion testing of Seaglider battery packs. Seaglider goes into the recovery state if the total 24V battery pack amp-hours used on a mission equals or exceeds this value.	145	1	150

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$ALT_TEL_NUM	The alternate telephone number Seaglider dials to connect to the basestation should it not be able to connect via the primary number, 13 digits maximum. The .pvt file for each dive records the set value for this parameter. This number is the PSTN number for the phone line connected to an alternate modem (if available) on a basestation for Seaglider operations. The format for the number is: international country code without leading zeros (for example, "1" for the US), then city/area code and number. There are no spaces or other interrupting characters between country code, city/area code or number. The **$ALT...** mechanism allows for automatic switching between two telephone numbers in the event of a communication failure. If a communication session using the primary phone number (**$TEL_NUM**) does not successfully connect (after **$CALL_TRIES** tries), the phone number is switched to the alternate number for the next surfacing. If a communication session completes successfully on the alternate phone number, the phone number is switched back to the primary for the next surfacing. **NOTE**: This parameter is not adjustable from the cmdfile. The number can be edited either through the pdoscmds.bat file (see *Appendix C, "Extended PicoDOS® Reference Manual, v66.07",* writenv on page 242), or through direct connection to Seaglider via the serial communications cable (see "Checking the primary and alternate phone numbers" on page 22).			

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$ALTIM_BOTTOM_PING_RANGE	The range (in meters) from the presumed apogee depth (the nominal depth at which Seaglider begins its apogee maneuver) to ping for the bottom. A value of 0 disables pinging. Only one attempt is made to sound for the bottom, unlike with **$ALTIM_PING_DEPTH.**	0	0	1000
$ALTIM_BOTTOM_TURN_MARGIN	The distance (in meters) from the altimeter detected sea floor (or an obstacle) at which to initiate the apogee maneuver (bottom turn). A value of 0 disables the use of the altimeter to determine the start of the apogee maneuver.	12	0	100
$ALTIM_FREQUENCY	Frequency (kHz) to use for altimeter pings.	13	10	25
$ALTIM_PING_DELTA	If the altimeter does not get a successful return and confirmation ping return at **$ALTIM_PING_DEPTH**, it continues to issue pings at depth intervals of **$ALTIM_PING_DELTA** meters. See **$ALTIM_PING_DEPTH.**	5	0	1000

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$ALTIM_PING_DEPTH	The depth of the first altimeter ping (meters), if nonzero. If the altimeter gets a return, and a return to an immediate second confirmation ping, it sets the bottom depth equal to the current depth plus the altimeter range to the bottom. The apogee maneuver is initiated at **$ALTIM_BOTTOM_TURN_MARGIN** meters above the bottom. If **$ALTIM_PING_DEPTH** is non-zero, the altimeter timeout is set so that the maximum range is the larger of 0.75***$ALTIM_PING_DEPTH** and 1.2***$ALTIM_TOP_PING_RANGE** if set. The first test is meant to exclude surface returns. **NOTE**: **$ALTIM_PING_DEPTH** and **$ALTIM_BOTTOM_PING_RANGE** modes are mutually exclusive. If **$ALTIM_BOTTOM_PING_RANGE** is set, it is honored to the exclusion of **$ALTIM_PING_DEPTH**.	80	0	1000
$ALTIM_PULSE	Pulse width (ms) of altimeter pings. The value must be an integer between 1 and 9.	3	1	9
$ALTIM_SENSITIVITY	Sensitivity (volts) of the envelope detector on the altimeter. The value must be an integer between 0 and 5. A value of 0 disables the envelope detector, causing the altimeter to trigger on any return at the right frequency. Values between 1 and 5 require that the return signal be above that voltage for the duration of a pulse width before triggering.	2	0	5
$ALTIM_TOP_MIN_OBSTACLE	Minimum obstacle depth (in meters) to honor in initiating a subsurface finish.	1	0	100
$ALTIM_TOP_PING_RANGE	Range (in meters) from the surface (this is simply depth) at which to ping the altimeter. A value of 0 disables a ping.	0	0	500

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$ALTIM_TOP_TURN_MARGIN	The distance (in meters) from an altimeter detected obstacle at which to initiate the subsurface finish. A value of 0 disables the use of the altimeter to determine the start of the sub-surface finish.	0	0	100
$APOGEE_PITCH	Intermediate pitch (position of the pitch mass) that Seaglider pitches to between the dive and climb phases, to prevent stalling. Seaglider changes from whatever pitch angle it used for the dive phase to **$APOGEE_PITCH** when it observes a depth of greater than the apogee depth (whether by **$D_TGT** or **$D_GRID**, or a bottom detection from the altimeter). The apogee maneuver also includes pumping the VBD to 0 cc. After the apogee maneuver, the climb is initiated by changing both pitch and VBD to the opposite-signed values from the dive.	-5	-20	0
$C_PITCH	The center (neutral or flat) position (A/D counts) for pitch.	2700 (Actual initial value obtained from vehicle's trim sheet.)	Software minimum of system obtained from the vehicle's trim sheet.	Software maximum of system obtained from the vehicle's trim sheet.
$C_ROLL_CLIMB	The center (neutral or straight flight) position (A/D counts) for roll during the climb (positive pitch control) phase. **NOTE**: The climb and dive roll centers will probably be different. This was implemented to correct for roll biases induced by physical asymmetries in Seaglider.	2025 (Actual initial value obtained from vehicle's trim sheet.)	Software minimum of system obtained from the vehicle's trim sheet.	Software maximum of system obtained from the vehicle's trim sheet.

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$C_ROLL_DIVE	The center (neutral or straight flight) position (A/D counts) for roll during the dive (negative pitch control) phase. **NOTE**: The climb and dive roll centers will probably be different. This was implemented to correct for roll biases induced by physical asymmetries in Seaglider.	2025 (Actual initial value obtained from vehicle's trim sheet.)	Software minimum of system obtained from the vehicle's trim sheet.	Software maximum of system obtained from the vehicle's trim sheet.
$C_VBD	The center (neutrally buoyant at a specified density) position (A/D counts) for VBD.	2900 (Actual initial value obtained from vehicle's trim sheet.)	Software minimum of system obtained from the vehicle's trim sheet.	Software maximum of system obtained from the vehicle's trim sheet.
$CALL_NDIVES	**CAUTION:** Use care when using **$CALL_NDIVES** in conjunction with **$N_NOSURFACE**. If you set **$N_NOSURFACE** and **$CALL_NDIVES** so that surface dives aren't supposed to call, they won't make the call, and the glider will be lost until it aborts due to low battery. The number of profiles (dive/climb cycles) to perform before attempting communications. Seaglider normally surfaces following each dive, and GPS fixes 1 and 2 are obtained at each surfacing, independent of the value of **$CALL_NDIVES**.	1	1	10
$CALL_TRIES	The maximum number of phone calls to attempt during a surfacing between dives. **$CALL_TRIES** is the only parameter that influences the ability to switch to the alternate telephone number.	5	1	20

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$CALL_WAIT	The wait time (seconds) between call attempts during a communication session. This is time to allow the Iridium satellite geometry to change and perhaps improve the connection.	60	0	600
$CAPMAXSIZE	Maximum size (in bytes, prior to compression) of the capture file to upload. If the capture file is to be uploaded (either due to critical output, **$CAPUPLOAD** set to 1, or a completed self test) and the capture file size exceeds this value, Seaglider creates a new capture file that is of the size requested, per the following strategy: • If there are no critical lines of output, then the first **$CAPMAXSIZE** bytes are sent. • If there are critical lines of output, then the new capture file consists of the first 20 of the critical output lines, with a window of output lines surrounding each critical line.	100000	1024	400000

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$CAPUPLOAD	A Boolean value that determines if the capture file from the current dive should be uploaded or not. 0 means do not upload the capture file. 1 means upload the capture file. **WARNING:** If a critical error occurs during a dive, the Seaglider will override a **$CAPULOAD** setting of 0 and force an upload of the capture file. If critical output is captured during a dive, or a self test has been completed, then the capture file is uploaded regardless of the value of **$CAPUPLOAD**. **NOTE**: Turn cap uploads off after dives are underway and going well to conserve energy and reduce Iridium charges.	1	0	1
$CF8_MAXERRORS Set by manufacturer. Do not change.	The maximum number (integer) of Compact Flash (CF8) errors allowed before Seaglider goes into recovery phase. A CF8 error is counted against the **$CF8_MAXERRORS** limit when a CF8 open or write call continues to fail (returns an error code) after three retries.	20	0	500

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$COMM_SEQ	The specification of the sequence of file transfer to use. A value of zero indicates the standard communication file transfer sequence: command (cmdfile), targets, science, current dive log file, current dive data file, earlier un-transferred log and data files, pdoscmds.bat, sgdddd.pz.nnn (the results of the pdoscmds.bat commands), and any other files as commanded in pdoscmds.bat. A value of 1 indicates skipping the normal log and data file transmission and going directly to pdoscmds.bat, so the sequence for file transfers becomes command (cmdfile), targets, science, pdoscmds.bat, sgdddd.pz.nnn and any other files as commanded in pdoscmds.bat. This was implemented as a way of getting to the pdoscmds.bat file in the event that communications problems or file corruptions prevented data transfers. It is a control mode to be used only when communications or other Seaglider problems exist.	0	0	1
$COMPASS_DEVICE Set by manufacturer. Do not change.	Configuration flags (integer) specifying the specific model and port for the compass and transponder/altimeter devices. This integer value is equal to (port_number + 16*type_number). For example, for a TCM2-50 (type **0**) on general purpose port 1, **$COMPASS_DEVICE** = 1 + 16*0 = 1 . The array of available models is specific to each device. The compass device must be defined (parameter cannot be -1). For transponders not connected to a serial port (for example, Benthos ENT-380), the null port (generally index 0) can be specified. See $DEVICE[1/2/3/4/5/6].	33	0	1023
$COMPASS2_DEVICE Set by manufacturer. Do not change.	Exactly the same as **$COMPASS_DEVICE**, except that it defines the second compass.	33	0	1023

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Parameter	Definition	Nominal value	Min value	Max value
$COMPASS_USE Set by manufacturer. Do not change.	This parameter was used in development to assess compass problems. It allows for faking inputs and outputs in compass calibration and reporting. For normal operations, it is set to 641, which yields current behavior of trusting inputs from the compass and using and reporting fully calibrated values.	641		
$COURSE_BIAS	A heading bias (degrees) to compensate for an observed tendency of Seaglider to veer to one side. This value is subtracted from the desired heading to produce the target heading.	0	-360	360
$CP_PROFILE	A current profiler command that specifies when the current profiler will record data: none, downcast only, upcast only or both down- and upcast. 0 - none 1 - downcast only 2 - upcast only 3 - down- and upcast			
$CP_RECORDABOVE	A current profiler command that sets the depth (in meters) above which the sensor will sample. A value of 0 turns the sensor off. Make sure and set this parameter to below the maximum depth the vehicle will go if the intent is to sample all the way through apogee.	1000	0	1100
$CP_RECORDAPOGEE	A current profiler command that specifies whether or not the sensor should be sampled during apogee or turned off. If the value is set to 1, the current profiler will sample through apogee. If the value is set to 0, the current profiler will be turned off during apogee.	1	0	1

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$CP_RECORDCONTINUOUS	A current profiler command that specifies whether or not to turn off the sensor during apogee and start a new cast. If the value is set to 1, the glider will not turn off the sensor during apogee. If the value is set to 0, the glider will turn off the sensor at the start of apogee or after apogee as defined by **$CP_RECORDAPOGEE**. If **$CP_RECORDCONTINUOUS** is set to 1, it overrides **$CP_RECORDAPOGEE** and **$CP_PROFILE**.	1	0	1
$CP_UPLOADMAX	The current profiler does not use this parameter.			
$CP_XMITPROFILE	A current profiler command that specifies whether data profiles from a dive should be transmitted to the basestation: none, transfer all telemetry. 0 - none 1 – transfer all telemetry			
$CURRENT Not user defined.	The depth averaged current (m/s, degrees, Boolean validity check) calculated by the glider when using **$NAV_MODE**, 2. For example: **$CURRENT**,0.035,283.8,1 There are three values: • current magnitude in m/s • current direction in degrees east of north • Boolean value indicates whether current estimate was judged valid by Seaglider			
$D_ABORT	The maximum depth (meters) for Seaglider operations. If this depth is reached, the dive is aborted and Seaglider immediately enters the recovery phase.	1020	0	1020

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$D_BOOST	The depth (meters) above which only the boost pump will run. If **$D_BOOST**=0, then both the boost pump and the main pump run simultaneously. If the value of **$D_BOOST** is greater than zero and the depth of Seaglider is shallower than **$D_BOOST** when VBD begins pumping, only the boost pump will be used. If Seaglider VBD starts pumping at a depth greater than **$D_BOOST**, then the **$D_BOOST** parameter is ignored and both pumps are used. If the VBD engine is retried, both the boost and main pumps will be turned on during retry.			
	If a ***STANDARD BUOYANCY ENGINE*** (SBE) is installed in the Seaglider, set **$D_BOOST** with values stated here. **NOTE**: The boost pump on the standard buoyancy engine is not capable of pumping oil to increase buoyancy below 5 m.	5	0	5
	If an ***ENHANCED BUOYANCY ENGINE*** (EBE) is installed in the Seaglider, **$D_BOOST** is used in conjunction with **$T_BOOST** with values stated here.	120	0	120
$D_CALL	A depth (meters) above which the glider will initiate the GPS acquisition and Iridium phone call portion of the surface maneuver. If this depth is not reached, a subsurface finish is executed. A value of 0 means the glider initiates the GPS acquisition and Iridium phone call at the surface.	0		

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$D_FINISH	The depth (meters) at which a dive is considered completed. Normally, this is 0, but can be a number greater than zero to specify the depth at which subsurface finish maneuvers should be started. Used only when an additional trigger to initiate a subsurface finish is present. (See **$N_NOSURFACE** on page 80.) **NOTE**: If a subsurface finish has been triggered by **$N_NOSURFACE** and **$D_FINISH >= $D_SURF**, then the dive will complete a subsurface finish. However, if a subsurface finish has been triggered by **$N_NO_SURFACE** and **$D_FINISH < $D_SURF**, the dive will finish at the surface.	0	0	1000
$D_FLARE	The depth (meters) at which Seaglider flares to the computed pitch angle following the initial dive from the surface. The guidance and control (G&C) action at the start of the dive phase maintains full pitch forward as VBD bleeding takes place. As soon as Seaglider reaches **$D_FLARE**, a new G&C action is initiated. Pitch is adjusted first (the flare), then VBD is adjusted (continued bleed to the target VBD) if it was not reached before **$D_FLARE**, and then roll is actuated to turn Seaglider to the correct heading.	3	0	990

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$D_GRID Not user defined.	The depth (meters) returned by the bathymetry map look-up routine, where apogee state begins, when **$USE_BATHY** does not equal 0. If **$USE_BATHY** is 0, **$D_GRID** is not used to determine the start of apogee depth. **Note**: If **$D_GRID** and the altimeter are active, the shallowest of the depths specified by **$D_GRID**, **$ D_TGT**, and the altimeter is used as the start of apogee state. This parameter is used with **$USE_BATHY**.			
$D_NO_BLEED	The depth (meters) below which Seaglider will not bleed (move) oil from the bladder into the internal reservoir on dives. This parameter is important during the deep dives because opening the bleed valve when there is a lot of pressure can cause it to get stuck in the open position.	200	1	600
$D_OFFGRID	The depth (meters) that the bathymetry map look-up routine returns in the event that the position of Seaglider is outside an area for which Seaglider carries a map. This parameter is used with **$USE_BATHY**.	100	10	1000
$D_PITCH	Depth (meters) that must be reached before the surface pitch maneuver is executed. If a depth shallower than this value is not reached, then execute a subsurface maneuver. A value of 0 means the surface pitch maneuver is executed at the surface.	0	0	5

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$D_SAFE	The target depth (meters) to use when flying an escape route and limiting the dive depth for VBD safety reasons. The escape is triggered by either VBD max errors exceeded or uncommanded bleed. If set to 0, the parameter is disabled.	0	0	990
$D_SURF	The depth (meters) at which Seaglider begins its approach to the surface. To collect data all the way to the surface, at **$D_SURF** Seaglider computes how many more data samples to take, based on the observed vehicle vertical speed, depth, and the data sample interval. The number of additional points is limited to 50. Seaglider then goes into passive guidance and control (G&C) mode and collects that number of data points at the appropriate sample interval for the depth range. When complete, Seaglider enters the surface phase. **NOTE**: This approach occasionally results in the last few data samples being taken when the conductivity sensor is actually in air, giving unrealistic conductivity values. These samples can be removed in shore side processing, if necessary.	3	0.5	10

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Parameter	Definition	Nominal value	Min value	Max value
$D_TGT	The nominal depth (meters) at which Seaglider begins the apogee phase, the transition from the negatively buoyant, pitch down dive to positively buoyant, pitch up climb. This depth is also used in conjunction with **$T_DIVE** to determine the specified vertical velocity for the dive and climb. The actual depth of the starting point of the apogee maneuver can be determined by reading a digital bathymetric map (**$D_GRID**), the altimeter, or **$D_TGT**. In either case, the vertical velocity specified by the combination of **$D_TGT** and **$T_DIVE** is retained by appropriate scaling of **$T_DIVE**. The apogee maneuver is not started until a depth greater than **$D_TGT** (or other depth trigger) is detected.	30	1	1000
$DEEPGLIDER	Indicates whether the glider is a standard Seaglider or a Deepglider. A zero indicates the glider is standard; 1 indicates the glider is a deep glider. **NOTE**: All Seagliders produced by iRobot Corporation are standard gliders with a maximum depth capability of 1000 m.			
$DEEPGLIDERMB	A Boolean value that indicates whether the main board is intended for use in Deepglider. A zero indicates the motherboard is intended for a standard glider; 1 indicates the motherboard is intended for a deep glider. **NOTE**: All Seagliders produced by iRobot Corporation are standard gliders with a maximum depth capability of 1000 m.			

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$DEVICE[1/2/3/4/5/6] Set by manufacturer. Do not change.	Configuration flags specifying device type and port for each of the six possible attached science sensors. Empty device slots are indicated with a parameter value of -1. Non-negative integer entries indicate that a device is attached. The encoding is specific to the version of the Seaglider software. These entries are set through the Seaglider menu system by the builders/assemblers.		-1	104
$DIRECT_CONTROL	Allows direct control of the pitch and buoyancy settings of the glider. If this parameter is set to 1, then buoyancy used will be **$MAX_BUOY** and the pitch chosen will be equal to the **$GLIDE_SLOPE** for the dive and climb.	0	0	1
$DIVE	The number of the next dive.	1	0	9999
$EBE_ENABLE	Enables Enhanced Buoyancy Engine (EBE) functionality. A value of 1 turns this functionality on.	0	0	1
$ES_PROFILE	An echo sounder command that specifies when the current profiler will record data: none, downcast only, upcast only or both down- and upcast. 0 - none 1 - downcast only 2 - upcast only 3 - down- and upcast			
$ES_RECORDABOVE	An echo sounder command that sets the depth (in meters) above which the sensor will sample. A value of 0 turns the sensor off. Make sure and set this parameter to below the maximum depth the vehicle will go if the intent is to sample all the way through apogee.	1000	0	1100

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$ES_RECORDAPOGEE	An echo sounder command that specifies whether or not the sensor should be sampled during apogee or turned off. If the value is set to 1, the echo sounder will sample through apogee. If the value is set to 0, the echo sounder will be turned off during apogee.	0	0	1
$ES_RECORDCONTINUOUS	An echo sounder command that specifies whether or not to turn off the sensor during apogee and start a new cast. If the value is set to 1, the echo sounder will not turn off the sensor during apogee. If the value is set to 0, the glider will turn off the sensor at the start of apogee or after apogee as defined by **$ES_RECORDAPOGEE**. If **$ES_RECORDCONTINUOUS** is set to 1, it overrides **$ES_RECORDAPOGEE** and **$ES_PROFILE**.	0	0	1
$ES_UPLOADMAX	The current profiler does not use this parameter.			
$ES_XMITPROFILE	An echo sounder command that specifies how many samples are taken at the surface and transmitted to the basestation: 0 - none 1 – one sample 2 - one sample 3 - two samples	3	0	3
$ESCAPE_HEADING	The base heading the Seaglider will steer in an escape recovery situation when either no position fix is available or no escape target was supplied in the targets file.	0		

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$ESCAPE_HEADING_DELTA	The actual heading steered by the Seaglider in an escape recovery situation will always be **$ESCAPE_HEADING** +/- **$ESCAPE_HEADING_DELTA**. The sign will switch (and thus the heading will toggle) when the bottom depth (as detected by altimetry or **$T_NO_W**) shallows by 5% relative to the depth at the last toggle.	10		
$FERRY_MAX	Maximum correction (degrees) to apply to the rhumb line to the active (next) waypoint when **$NAV_MODE** = 2. This is a safety limit to prevent spurious depth-averaged current calculations from giving Seaglider a heading in the wrong direction.	45	0	90
$FILEMGR Set by manufacturer. Do not change.	An integer parameter that specifies how aggressively to manage the onboard file system. 0 = No file management 1 = Only store compressed files 2 = Delete splits on failed phone call	0	0	2
$FIX_MISSING_TIMEOUT Set by manufacturer. Do not change.	An integer used only for debugging.	0		
$GC_LAST_COLLECTION	The **$GC_LAST_COLLECTION** parameter stores the last dive garbage collection was performed on. In general this value is **$GC_WINDOW** dives behind the current dive number. This value is set to -1 on sea and test launches. Dives which are less than **$GC_LAST_COLLECTION** will not be garbage collected. This parameter should generally be left alone, if you wish to modify please contact iRobot for further information. Resetting this value to -1 can result in a long delay for garbage collection if a significant number of dives have been performed.	-1	-1	9999

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$GC_WINDOW	The **$GC_WINDOW** parameter configures the garbage collection to retain at most **$GC_WINDOW** split files to be transferred to the base station that haven't been successfully transferred up to this point. Split files from earlier dives will be removed however the archived data will remain. To disable garbage collection, set the **$GC_WINDOW** to 0.	20	0	100
$GLIDE_SLOPE	The absolute value of the maximum glide slope (degrees) allowed for Seaglider. The glide slope is calculated on-board Seaglider to best achieve the goals of the next dive. The stall angle provides the lower limit; this parameter is the upper limit.	30	10	90
$GPS_DEVICE Set by manufacturer. Do not change.	A configuration value specifying the model of the attached GPS device. These devices have dedicated hardware ports on all motherboard revisions and as such a port specification is not necessary. A GPS device must be defined (cannot be -1).	32	0	1023
$HD_A	The hydrodynamic parameter representing the lift coefficient, determined empirically and used in on-board performance prediction and guidance calculations.	0.003836	0.001	0.005
$HD_B	The hydrodynamic parameter representing the drag coefficient, determined empirically and used in on-board performance prediction and guidance calculations.	0.010078	0.001	0.02
$HD_C	The hydrodynamic parameter representing the induced drag coefficient, determined empirically and used in on-board performance prediction and guidance calculations.	9.85E-06	0	0.0001

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$HEAD_ERRBAND	Deadband for heading (degrees). This value is used to determine if a correction to heading is required during an active guidance and control (G&C) mode. If the absolute value of the difference between the actual heading and the desired heading is less than or equal to **$HEAD_ERRBAND**, no heading correction is made. If the difference is greater than **$HEAD_ERRBAND**, then a turn is performed until the heading is passed, or until the amount of time **$T_TURN** has elapsed.	10	0	180
$HEADING	Floating point value between -1.0 and 360.0 (true degrees, 0.0 and 360.0 are equivalent values). Used in conjunction with certain navigation modes (controlled by the **$NAV_MODE** parameter) to determine the course steered by the Seaglider. If **$NAV_MODE** is 0, 1, or 2 and the value of **$HEADING** is between 0.0 and 360.0, the glider will use this value to synthesize a waypoint 20 km distant on the specified bearing from the current location. If **$NAV_MODE** is 3, **$HEADING** is added to the depth-averaged current calculated for the previous dive, to give a Seaglider heading that is the specified amount to the right of the current	-1	-1	360
$HEAPDBG Set by manufacturer. Do not change.	A Boolean value set during fabrication or building that is only used for debugging.	0		
$ID Set by manufacturer. Do not change.	Seaglider identification (serial) number. This is an integer between 1 and 999. Leading zeros are not required. This identification number is used in many ways, including creating Seaglider login on the basestation, in filenaming conventions and as a serial number for manufacturing purposes.	Set at factory (>500)	1	999

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$INT_PRESSURE_SLOPE Set by manufacturer. Do not change.	The slope (psia per A/D count) calibration of the internal pressure sensor. The sensor has a span of 0 to 30 psia, with a 90 mV output at full-scale at 12 V excitation. The output is proportional to the supply. The Seaglider excitation is 4.096 V and the gain is 100, so 30 psia = 90*4.096/12*100*1. Full-scale = 90*4.096*gain*counts/mV, so the nominal slope is 0.009766 psia per A/D count.	0.009766	0.001	1
$INT_PRESSURE_YINT Set by manufacturer. Do not change.	The y-intercept of the linear calibration of the internal pressure sensor.	0	-5	5
$KALMAN_USE	The control parameter for the run state of the Kalman filter navigation program. The **$NAV_MODE** parameter controls whether the Kalman filter output heading is used to control Seaglider. This separation of functions allows the Kalman filter to be run, but not used, while it "learns" the currents. 0 = Reset the Kalman state vector and origin of local Kalman coordinate system to 0 and restart the filter. 1 = Run the Kalman filter 2 = Do not run the Kalman filter **Examples** • If **$KALMAN_USE** is 0 or 1, and **$NAV_MODE** is 1, the **$KALMAN_USE** filter results are used to determine the Seaglider heading. • If **$NAV_MODE** is 1 and **$KALMAN_USE** is 2 (not being run), Seaglider will choose the heading directly to the target it is attempting to achieve and fly on that heading without attempting to make any corrections for currents.	2	0	2

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$LENGTH Set by manufacturer. Do not change.	Length in meters of the Seaglider direct control.	1.8 (standard fairing) 2 (Ogive)		
$LOGGERS	A bit mask that tells Seaglider which of the autonomous logging devices configured with the Autonomous Logger Interface (ALI) to use. When **$LOGGERS** is set to 0, no ALI devices will be run during self tests or dives. When **$LOGGERS** is set to > 0, the installed ALI sensors are turned on according to the following bitmask. An X means the ALI sensor is running. **$LOGGER** value Sensor 1 Sensor 2 0 1 X 2 X 3 X X	7	0	15
$MASS Set by manufacturer. Do not change.	The mass of Seaglider in grams. This value is used in on-board buoyancy and current estimation calculations.	52000	500000	54000
$MAX_BUOY	The absolute value of the maximum negative thrust (in cc) that Seaglider is allowed to develop during the dive phase. There is no restriction on buoyancy during the climb phase.	150	0	600
$MEM	An output from the glider specifying the amount of free RAM in bytes. **Note**: This value is *not* the space on the compact flash card.			
$MINV_10V	The minimum allowable observed voltage on the 10 volt battery pack before the glider will stop diving and go into recovery. A zero disables the check.	8		

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$**MINV_24V**	The minimum allowable observed voltage on the 24 volt battery pack before the glider will stop diving and go into recovery. A zero disables the check.	19		
$MISSION	The current Seaglider mission number. This value is intended to be unique for each deployment of a particular Seaglider. It has no effect on Seaglider operations, but is reported back in data files for the purpose of data file distinction from other missions a Seaglider may have performed.	0	0	999
$MOTHERBOARD Set by manufacturer. Do not change.	An integer value indicating the motherboard revision carried by Seaglider.	4		
$N_FILEKB	An integer value (**$N_FILEKB**), which is the size (in kilobytes) and type (gzip-compressed or uncompressed) of file used for data uploading. Positive numbers direct Seaglider to first use gzip to compress the data file, then split it into **$N_FILEKB**-sized pieces. Negative values for **$N_FILEKB** disable the gzip compression, but still cause the non-gzipped binary data file to be split into **$N_FILEKB**-sized pieces before transmission. A value of 0 means no splitting or compression is performed.	4	-16	16
$N_GPS	The maximum number of seconds to wait after the first GPS fix is received for a GPS fix with HDOP that is less than 2.0. If no such fix is acquired, the last (most recent) GPS fix is used, which is probably, but not necessarily, the most accurate fix available in the specified time period.	20	1	60

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$N_NOCOMM	The number of dives that are allowed to occur without a complete and successful data communication session, before the surface buoyancy parameter **$SM_CC** is set to the maximum allowed by the software limits. This is a safety provision in the event **$SM_CC** is not sufficient to allow for a good antenna position.	1	0	10
$N_NOSURFACE	⚠ **CAUTION:** Use care when using **$N_NOSURFACE** in conjunction with **$CALL_NDIVES**. If you set **$N_NOSURFACE** and **$CALL_NDIVES** so that surface dives aren't supposed to call, they won't make the call, and the glider will be lost until it runs out of battery. An integer value that determines when the Seaglider will finish the dive at **$D_FINISH** and when it will finish at the actual surface. For values greater than 1, the rule is that when the remainder of **$DIVE** divided by **$N_NOSURFACE** is zero, Seaglider finishes the dive at depth **$D_FINISH**. Other dives finish at the surface. For negative values less than -1, this logic is reversed and the values of **$DIVE** divisible by the absolute value of **$N_NOSURFACE** finish at the surface; all others will be subsurface finishes. In addition to **$N_NOSURFACE** not having a remainder for the maneuver to be initiated, **$D_FINISH** must be >= **$D_SURF** for Seaglider to complete a subsurface finish. If a subsurface finish is triggered by **$N_NOSURFACE** and **$D_FINISH** < **$D_SURF** the dive ends at the surface. Values of 1 and -1 are not allowed. A value of 0 disables this behavior.	0	-10	10

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$N_NOSURFACE (Continued)	**NOTE**: Other considerations when using **$N_NOSURFACE**; when **$N_NOSURFACE** is not equal to 0, Seaglider will not acquire GPS fixes when it completes a dive subsurface. As a result, **$NAV_MODE**, 0 and **$NAV_MODE**, 1 should be used when **$N_NOSURFACE** is not equal to zero. If **$NAV_MODE** is set to 1, set **$KALMAN_MODE** to 2. Only **$NAV_MODE** 0, which causes the glider to steer a specific heading, should be used when **$N_NOSURFACE** is not equal to zero. Additionally, when **$NAV_MODE** is set to 0, the **$HEADING** parameter must be set to a value between 0 and 360. For example, if **$N_NOSURFACE** is set to 5, **$NAV_MODE** is set to 0, and **$HEADING** is set to 90, then Seaglider will surface and acquire a GPS position and initiate a communication session with the basestation only on dives that are evenly divisible by 5. On all dives, the glider will point its nose due east and will not be able to compensate for currents. If GPS positions need to be obtained on each dive to enable all **$NAV_MODE** options yet surface time needs to be minimized, **$CALL_NDIVES** can be set to a value greater than 1. This directs the glider to surface and obtain a GPS fix after each dive but not attempt to establish a communication session with the basestation until the number of dives since the last communication equals **$CALL_NDIVES**.			

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$NAV_MODE	An integer value specifying the method used to choose a heading for Seaglider to maintain on the next dive, according to the following values: 0 = Steer constant heading (**$HEADING**) 1= Kalman filter (see $KALMAN_USE), Seaglider uses the past current information gathered by the Kalman filter to correct the flight path for the next dive. Use settings **$NAV_MODE,1** and **$KALMAN_USE,2** when using **$N_NOSURFACE**. When **$NAV_MODE** = 1 and **$KALMAN_USE** = 2, the heading is calculated based on GPS and target, with no correction for currents. 2 = Ferry angle correction with respect to the calculated depth-averaged current. 3 = Steer relative to the depth-averaged current. **NOTE**: If heading is set to something other than -1, it WILL be used instead of waypoint in ANY mode. If the pilot wants to fly by waypoint rather than heading, **$HEADING** must be set to -1. Navigation flow proceeds as follows: 1. If a valid depth-averaged-current (DAC) has been calculated and **NAV_MODE** = 3 (steer relative to DAC), synthesize a heading = current direction + **$HEADING**. 2. If a synthesized heading exists from (1) or **$HEADING** >= 0, synthesize a target 20 km away at a true bearing given by that heading. Otherwise, choose a target based on the usual selection process. Calculate range and bearing to the target.	2	0	3

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$NAV_MODE (Continued)	3. Modify the dive time and depth as needed to honor safeties and grids. Calculate speed limits - Seaglider minimum and maximum possible horizontal speeds through the water. The speed limits and dive times fix the range of possibilities for the distance through the water. 4. Choose a glide slope that gets Seaglider closest to the target (maximum speed if the target is distant, minimum speed if the target is too close). 5. At this point Seaglider has a bearing and glide slope in hand. If **$NAV_MODE** = 0 , **$NAV_MODE** = 1, or **$NAV_MODE** = 3, then these are the heading and slope for this dive. 6. If **$NAV_MODE** = 2 (calculate set/ferry angle correction) and we have calculated a valid DAC, we apply **$SPEED_FACTOR** to the speed limits to account for the fact that Seaglider actually won't achieve its ideal speed over the entire dive. We then iteratively calculate set corrections as a function of our horizontal speed through the water so that we optimize the Seaglider system's travel toward the target (just as we chose our slope above). At each speed setting, the code uses a nonlinear solver to solve for ferry angle. First guess at speed is maximum. If the predicted distance over ground (DOG) with the set correction is less than the range to target (typical case) then the computation is complete. Otherwise we try the minimum speed. If the resulting DOG is greater than the range to target then the computation If neither limit applies, we iterate via bisection to settle on the best speed.			

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Parameter	Definition	Nominal value	Min value	Max value
$NAV_MODE (Continued)	At convergence, Seaglider has a ferry angle to steer and a horizontal speed to apply. The predicted horizontal speed is used to calculate a new value for glide slope.			
$P_OVSHOOT	The distance (cm) by which the pitch mass is allowed to overshoot its target after the pitch motor is turned off.	0.04	-0.1	0.1
$PC_INTERVAL	A pumped CTD command that specifies the sampling interval in seconds. • 1-4 second sampling intervals The CTD is in Continuous Sampling Mode. The pump and all sampling circuitry remain on continuously. Power consumption for any of these sampling intervals is the same. However, memory usage decreases with increasing sampling interval. • 5-14 second sampling intervals The CTD is in Fast Sampling Mode. The pump runs continuously and measurements are made at the chosen interval. • 15-3600 second sampling intervals The CTD is in Slow Interval Sampling Mode. In this mode, CTD samples are taken but DO samples are not. The pump runs for 11.3 seconds prior to a measurement and an additional 2.1 seconds during the measurement. In-between sampling intervals, the pump is off and the CTD is in low power state.	1		

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Parameter	Definition	Nominal value	Min value	Max value
$PC_MINCONDFREQ	Minimum conductivity frequency detected to cause the GPCTD pump to run. This value is only transmitted to the sensor when a single sample operation is performed, such as a self test or a manual execution from the ALI menu. The value of this parameter should be 500 Hz greater than the frequency response of the sensor in freshwater. This value is listed in the sensor calibration sheet.			
$PC_PROFILE	A GPCTD command that specifies when the CTD will record data: none, downcast only, upcast only or both down- and upcast. 0 = None 1 = Downcast only 2 = Upcast only 3 = Downcast and upcast	3		
$PC_RECORDABOVE	A GPCTD command that sets the depth (in meters) above which the sensor will turn sample. A value of 0 turns the sensor off.	1000	0	1100
$PC_RECORDAPOGEE	A GPCTD command that specifies whether or not the sensor should be sampled during apogee or turned off. If the value is set to 1, the current profiler will sample through apogee. If the value is set to 0, the GPCTD will be turned off during apogee.	1	0	1
$PC_RECORDCONTINUOUS	A GPCTD command that specifies whether or not to turn off the sensor during apogee and start a new cast. If the value is set to 1, the glider will not turn off the sensor during apogee. If the value is set to 0, the glider will turn off the sensor at the start of apogee or after apogee as defined by **$PC_RECORDAPOGEE**. If **$PC_RECORDCONTINUOUS** is set to 1, it overrides **$PC_RECORDAPOGEE** and **$PC_PROFILE**.	0	0	1

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Parameter	Definition	Nominal value	Min value	Max value
$PC_STARTS	A diagnostic value output by the GPCTD, that keeps track of the number of times the sensor restarts during a mission. There should be two restarts per dive: one for the downcast and one for the upcast.			
$PC_UPLOADMAX	The **$PC_UPLOADMAX** parameter is currently unused by the GPCTD.			
$PC_XMITPROFILE	A GPCTD command that specifies which data profiles from a dive are transmitted to the basestation: none, downcast only, upcast only or both down- and upcast. 0 = None 1 = Dive 2 = Climb 3 = Both	3		
$PHONE_DEVICE Set by manufacturer. Do not change.	A configuration value specifying the model of the attached These devices have dedicated hardware ports on all motherboard revisions and, as such, a port specification is not necessary.	48	0	1023
$PHONE_SUPPLY	(Set by manufacturer. Do not change.) A parameter that tells the glider where to attribute Iridium modem power usage to, either the 24V or 10V battery. 1 - 10 V battery 2 - 24 V battery			
$PITCH_AD_RATE Set by manufacturer. Do not change.	The pitch rate (A/D counts/second) used as the threshold for retries when pitching. If the observed rate is less than this number, the pitch motor is stopped and restarted. The glider continues to monitor speed and retry if the speed dips below the set value until the timeout is reached; then an error is declared.	175	0	200

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Parameter	Definition	Nominal value	Min value	Max value
$PITCH_ADJ_DBAND	This parameter (degrees), with **$PITCH_ADJ_GAIN**, enables and adjusts active (closed-loop) control on Seaglider pitch during a dive and climb. Seaglider automatically seeks to maintain the pitch angle by moving the pitch mass when: \| Pitch observed - Pitch desired \| >**$PITCH_ADJ_DBAND** **NOTE**: A value of 0 disables automatic pitch adjustment.	1	0	40
$PITCH_ADJ_GAIN	This parameter, with **$PITCH_ADJ_DBAND**, enables and adjusts active (closed-loop) control on Seaglider pitch during a dive and climb. The amount of the adjustment is given by: (Pitch Desired - Pitch Observed)***** **$PITCH_ADJ_GAIN** **$PITCH_ADJ_GAIN** has units of cm/degree. Adjustments are calculated at the beginning of the active guidance and control (G&C) phase, based on the pitch observed over the same samples for which observed vertical speed is calculated. Adjustments are not made during the first two active G&C phases following the start of a dive or climb. A value of zero disables automatic pitch adjustment. If the glider is driven into pitch oscillation by adjustments during dive, reduce **$PITCH_ADJ_GAIN** until the system becomes stable. If the glider is not achieving the desired pitch during the dive, adjust **$PITCH_ADJ_GAI**N upward until system becomes stable at desired value over course of dive.	0.02	0	0.1

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Parameter	Definition	Nominal value	Min value	Max value
$PITCH_CNV Set by manufacturer. Do not change.	The pitch position conversion factor, from A/D counts to centimeters (cm/AD count). This is a constant determined by the pitch of the worm gear that drives the pitch motion, and is set at the factory by the builder or assembler.	0.003125763 Old style mass shifter: 0.0046		
$PITCH_DBAND	The pitch position deadband (cm) within which no further pitch motion will be commanded.	0.01	0	1
$PITCH_GAIN	The amount of vehicle pitch (degrees) change corresponding to a 1 cm movement of the pitch mass.	30	15	40
$PITCH_MAX Set by manufacturer. Do not change.	Pitch position software limit (A/D counts) aft. **NOTE**: Value determined by the software maximum of the system. Obtain actual value from the vehicle's trim sheet.	4000		
$PITCH_MAXERRORS Set by manufacturer. Do not change.	**CAUTION:** An error in the pitch could lead to the loss of Seaglider.	1	0	100
$PITCH_MIN Set by manufacturer. Do not change.	Pitch position software limit (A/D counts) forward. This is also the value to which the pitch mass moves during the surface maneuver (fully forward for maximum pitch down). **NOTE**: Value determined by the software minimum of the system. Obtain actual value from the vehicle's trim sheet.	100		
$PITCH_TIMEOUT Set by manufacturer. Do not change.	Pitch mass timeout (seconds). If the mass shifter does not achieve the desired pitch position before **$PITCH_TIMEOUT** seconds, a pitch error occurs.	16	15	25

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$PITCH_VBD_SHIFT Set by manufacturer. Do not change.	The pitch compensation (cm/cm^3) required to balance the mass of the hydraulic oil moving forward and aft with the change in buoyancy as a result of VBD changes. When flying a Seaglider configured with Ogive fairings, it is recommended to use this parameter when trimming pitch.	0.00005 Old style mass shifter: 0.00123	0 0	0.01 0
$PRESSURE_SLOPE Set by manufacturer. Do not change.	Slope of linear fit between psig and pressure sensor output (after digitization to A/D counts through AD7714). The fit is calculated from calibration data received with each pressure sensor, and converted to A/D counts knowing the configuration of the AD7714 and associated circuitry. This number is a constant for each pressure sensor and associated calibration.			
$PRESSURE_YINT	Y-intercept of linear fit between psig and pressure sensor output (after digitization to A/D counts through AD7714). This is the value that is adjusted in the field at launch to correct the pressure sensor relative to atmospheric pressure at 0m depth.		-50	50

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$R_PORT_OVSHOOT	Roll mass overshoot (A/D counts) to port after roll motor is turned off. Overshoots are assumed to be positive, in the sense of past the desired position. The sign of the **$R_PORT_OVSHOOT** parameter indicates how the code handles the overshoots, not a direction. Positive values allow the Seaglider operating software to automatically compute the roll overshoots and apply them after each roll maneuver. Negative values allow the pilot to specify a static overshoot value to be applied uniformly to each roll maneuver. In the case where Seaglider is computing and applying the roll overshoots, the value reported in the log file is the last value computed during a dive.	25	-100	100
$R_STBD_OVSHOOT	Roll mass overshoot (A/D counts) to starboard after motor is turned off. For more details, see **$R_PORT_OVSHOOT**.	25	-100	100
$RELAUNCH Set by manufacturer. Do not change.	**CAUTION:** Do not change default value of 0. Loss of Seaglider can result if this parameter is changed. The **$RELAUNCH** parameter controls the behavior of the Seaglider when a reboot condition occurs. When **$RELAUNCH** is 0 and a reboot occurs, the Seaglider will enter Recovery. When **$RELAUNCH** is 1 and a reboot occurs, the Seaglider will continue its current missions.	0		

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$RHO	The water density (kg/m^3) used for converting buoyancy force in grams to seawater displacement in cm^3. This parameter is also used in the on-board performance prediction computations. Set this value to match the bottom water density of the environment the glider is operating in.	1.026	1	1.04
$ROLL_AD_RATE	The roll rate in A/D counts per second that the operating code of the Seaglider uses as the threshold for retries when rolling. If the observed rate is less than this number, the roll is stopped and restarted. The glider continues to monitor speed and retry if speed dips below the set value until the timeout is reached; then an error is declared.	350	100	450
$ROLL_ADJ_DBAND	This parameter, in conjunction with **$ROLL_ADJ_GAIN**, controls the automatic adjustment of the roll centers based on observed turn rate. At the end of a complete passive phase, a full guidance and control (G&C) interval, Seaglider adjusts the appropriate dive or climb roll center based on the turn rate over the last half of the passive phase if: \|turn rate\| > **$ROLL_ADJ_DBAND** **$ROLL_ADJ_DBAND** has units of degrees/second. A value of zero disables automatic adjustment of the roll centers.	0	0	1000

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$**ROLL_ADJ_GAIN**	This parameter, with **$ROLL_ADJ_DBAND**, controls the automatic adjustment of the Seaglider roll centers based on observed turn rate. If climbing, the amount of the adjustment is: -(turn rate)***$ROLL_ADJ_GAIN** If diving, the amount of adjustment is: (turn rate)***$ROLL_ADJ_GAIN** **NOTE**: Turn rate has units of degrees/second. This adjustment is only meaningful the next time Seaglider turns, as Seaglider rolls back to this new neutral position on the next turn. It will not immediately roll from the old neutral position to the new neutral position at the start of the next active G&C phase. If **$HEAD_ERRBAND** is large, then several active/passive G&C phases might pass before a turn is initiated and the new roll center is used. A new adjustment is computed only after a turn has been completed.	0	0	1000
$ROLL_CNV Set by manufacturer. Do not change.	Roll position conversion factor, from A/D counts to degrees. This is a constant determined by the design of the roll gear train, motor, and potentiometer.	0.028270001		
$ROLL_DEG	The number of degrees to roll the mass shifter during a turn.	40	0	60

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Parameter	Definition	Nominal value	Min value	Max value
$ROLL_GAIN_P	Allows proportional control of roll mass movement for closed-loop heading control. If **$ROLL_GAIN_P** is 0, then it has no effect. However, if **$ROLL_GAIN_P** is not equal to zero, the following algorithm describes the amount of roll mass movement that will be used for a heading correction: if |DesiredHeading_deg - ActualHeading_deg| * **$ROLL_GAIN_P** > **$ROLL_DEG** Roll mass moves to **$ROLL_DEG** in desired direction else NewRollMove_deg = \|DesiredHeading_deg - ActualHeading_deg\| * **$ROLL_GAIN_P** Roll mass moves to NewRollMove_deg in desired direction **NOTE:** The operation shown as DesiredHeading_deg - ActualHeading_deg in the glider software accounts for yaw axis singularity. For example the error between DesiredHeading_deg of 5 and ActualHeading_deg of 355 is not -350, rather it is 10 degrees. In other words, error can be no larger than 180 degrees or it must be adjusted by adding or subtracting 360 degrees.	0	0	5
$ROLL_MAX Set by manufacturer. Do not change.	Roll position software limit (A/D counts) to starboard. The glider's operating software stops the mass shifter at this value when rolling to starboard. **NOTE**: Value determined by the software maximum of the system. Obtain actual value from the vehicle's trim sheet.	4000		
$ROLL_MAXERRORS Set by manufacturer. Do not change.	The number of roll motor errors allowed before Seaglider goes into recovery phase. An error occurs when the **$ROLL_TIMEOUT** expires prior to achieving the commanded roll A/D position.	1	0	100

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$ROLL_MIN Set by manufacturer. Do not change.	Roll position software limit (A/D counts) to port. The Seaglider operating software stops the mass shifter at this value when rolling to port. **NOTE**: Value determined by the software minimum of the system. Obtain actual value from the vehicle's trim sheet.	50		
$ROLL_TIMEOUT Set by manufacturer. Do not change.	Roll maneuver timeout (seconds). If the mass shifter does not achieve the desired roll position before **$ROLL_TIMEOUT** seconds, a roll error occurs.	15	10	20
$SEABIRD_[C_G/ C_H/ C_I/ C_J/ T_G/ T_H/ T_I/ T_J] Set by manufacturer. Do not change.	Sea-Bird Electronics provides calibration coefficients for their free flow conductivity and temperature sensor on Seaglider. These values are used to compute calibrated temperature and salinity for hardware test purposes and in situ density for self-trimming applications. Currently used for subsurface finish maneuvers in which Seaglider attempts to become neutral at a fixed depth below the surface. Parameters that begin with **$SEABIRD** may be flagged by Seaglider during self-test as being out of range. The acceptable parameter ranges have changed since ranges used for the check were written into the software. For the Sea-Bird parameters ONLY this warning can be ignored. The parameters are installed at the factory, based on the calibration sheets delivered with the CT sensor and should not be changed.			

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$SIM_PITCH	Simulated Seaglider pitch angle (degrees) during the dive phase of a simulated run. This parameter is automatically zeroed during the Sea Launch procedure. A value of 0 disables this feature. For simulated dives, a **$SIM_PITCH** value of -20 is often used. If non-zero, this value is used in place of observed pitch on the dive phase of a simulated run.	-20		
$SIM_W	Simulated Seaglider vertical velocity (m/s). This parameter is automatically zeroed during the Sea Launch procedure. A value of 0 disables this feature. For simulated dives, a **$SIM_W** value of 0.1 is often used. If non-zero, this value is used to generate depths so that Seaglider can do simulated dives in the lab or on the deck.	0.1		
$SM_CC	The specified minimum buoyancy value of the VBD (cm^3) that Seaglider attains at the surface. If Seaglider enters the surface maneuver with less than the minimum buoyancy value of VBD, it pumps to this value. If Seaglider enters the surface maneuver with more than the minimum buoyancy value specified, it does not change the value of VBD and continues to the next part of the surface maneuver.	650	150	700

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$SPEED_FACTOR	A factor to compensate for the inability of Seaglider to dive at the desired horizontal velocity. This is a measure of the efficiency of Seaglider's progress along a specified track. Factors that lower the efficiency of Seaglider are turns, leaving the surface at arbitrary headings, and reduced horizontal speed during the apogee maneuver. **$SPEED_LIMITS** are multiplied by this factor and **$KALMAN_CONTROL** components are divided by it.	1	0.1	1
$T_ABORT	A safety time (minutes) such that if the elapsed time on a given dive exceeds this time, Seaglider enters the recovery state.	720	(T_DIVE) (1.4)	4320
$T_BOOST	Time (seconds) to run the boost pump in before it turns off when the glider is deeper than **$D_BOOST**. **$T_BOOST** must be set to 0 if an EBE is not installed in the glider. If **$T_BOOST** is > 0, and the glider is deeper than **$D_BOOST** at the start of the pumping maneuver, the boost pump runs by itself for the first 2 seconds. Then, both pumps run simultaneously for the remainder of **$T_BOOST** seconds. At the end of **$T_BOOST** seconds, the boost pump turns off while the main pump continues to run. **NOTE**: It is recommended that if the desired **$T_BOOST** is > 0 that the value be at least 3 seconds. This allows a 1 second operational overlap of the two pumps before the boost pump turns off.	0	0	20
$T_BOOST_BLACKOUTS Set by manufacturer. Do not change.	Time in seconds to wait after boost pump is disabled before allowing a retry.	0	0	30

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$T_DIVE	The time (minutes) for Seaglider to make one dive-climb cycle to the depth **$D_TGT** and back to the surface. This value does not include the time for pumping during the apogee phase. The value is used to calculate the desired vertical velocity in a particular dive, using the naive calculation: w_d (cm/s) = 2***$D_TGT****100/(***$T_DIVE****60) The w_d is combined with **$MAX_BUOY**, the range to the target and the Seaglider hydrodynamic model to calculate the Seaglider pitch angle on any given dive.	10	5	2880
$T_GPS	The maximum allowed time (minutes) to obtain a GPS position (GPS timeout). **$T_GPS** is typically set to longer than 12.5 minutes, in order to ensure that the GPS receiver has time to receive a complete set of almanac entries in the event that lack of an almanac prevents getting a timely fix.	15	1	30
$T_GPS_ALMANAC	Time to wait (in minutes) to acquire the GPS almanac. The wait happens the next time the GPS is turned on. After the wait, the parameter resets to zero and the regular GPS operation (presumably a fix) will proceed. If the parameter is greater than zero, then the almanac sentences are checked every minute. The wait halts when the time has expired or at least ten satellites have recent almanac sentences. If the parameter is negative, then the wait only halts after the time has expired. A negative value also forces a complete NVRAM reset before the wait starts.	0	-15	15

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$T_GPS_CHARGE	Time to wait (seconds) before trickle-charging the GPS receiver (for Garmin GPS25 engines only). Negative values mean the GPS25 does not need charging. The GPS units now installed in Seagliders run on a button battery so there is no need to charge the system.	-0.0033		
$T_LOITER	The time (seconds) to loiter after going neutral at apogee, before pitching up and becoming positively buoyant for climb. While in the loiter state Seaglider will attempt to maintain zero vertical velocity. It will pump, but not bleed (become heavier) to do this. Seaglider does not servo on depth in this state. All other timeouts and depths are honored in this state. **$T_MISSION** and **$T_ABORT** need to be adjusted manually to account for the additional dive duration. Total dive duration is **$T_DIVE** + **$T_LOITER**. G&C and sampling intervals during the loiter state are controlled by the appropriate depth bins in the science file.	0	0	86400
$T_MISSION	The maximum mission time (minutes) allowed. After **$T_MISSION** divided by two, Seaglider transitions from dive phase to apogee phase, then commences the climb phase. If **$T_MISSION** is reached prior to Seaglider reaching **$D_SURF**, Seaglider immediately enters the surface phase. This time includes the dive, apogee, and climb phases.	15	10	4320

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Parameter	Definition	Nominal value	Min value	Max value
$T_NO_W	The time (seconds) for Seaglider to wait with no significantly non-zero vertical velocity (less than 1 cm/s, as measured by dP/dt) before proceeding to the next phase of a dive. This is primarily used to move from the dive phase to the climb phase (initiate an apogee maneuver) when Seaglider unexpectedly encounters the bottom. **NOTE**: This protection is only in place at depths below **$D_FLARE** and VBD is already at **$MAX_BUOY** or below.	120	30	86400
$T_RSLEEP	The sleep time interval (minutes) during the recovery phase. During the recovery phase, Seaglider first gets a GPS fix, then calls the basestation up to **$CALL_TRIES** times to upload the GPS fix, then goes into low power sleep for **$T_RSLEEP** length of time. The surface evolution has about 2 minutes of “overhead,” so that Seaglider calls are about (**$T_RSLEEP** + 2) minutes apart in practice.	3	0	14400
$T_TURN	The maximum amount of time (seconds) allowed to complete a turn during the active G&C mode. If this timeout is reached before the heading is reached, Seaglider rolls back to neutral and continues.	225	10	720
$T_TURN_SAMPINT	The sample interval during active and passive G&C while turning. This should be short enough so that Seaglider cannot pass entirely through the heading deadband without sampling.	5	4	120

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Table 5-4. Parameters in alphabetic order

Parameter	Definition	Nominal value	Min value	Max value
$T_WATCHDOG Set by manufacturer. Do not change.	The value to which the watchdog timer is set (minutes). This is an information only parameter so the Seaglider software knows the watchdog timer value. The watchdog timer itself is set with DIP-switches on the main board. If the watchdog timer expires, the main processor is reset, and Seaglider goes into recovery. This will not happen during normal operation and is meant as a fail- safe against unexpected software or hardware failures.	10		
$TCM_PITCH_OFFSET Set by manufacturer. Do not change.	Static offset in pitch axis (degrees) between the compass output and the actual Seaglider body, as measured in the lab.	0		
$TCM_ROLL_OFFSET Set by manufacturer. Do not change.	Static offset in roll axis (degrees) between the compass output and the actual Seaglider body, as measured in the lab.	0		

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Parameter	Definition	Nominal value	Min value	Max value
$TEL_NUM	The telephone number Seaglider dials to connect to the basestation, 13 digits maximum. The .pvt file for each dive records the set value for this parameter. This is the PSTN number for the phone line connected to the first modem on a basestation for Seaglider operations. Format of the number: It starts with the international country code, without leading zeros (for example, 1 for the US), then city/area code and number. There are no spaces or other interrupting characters between the country code, city/area code, or number. If a communication session using the primary phone number (**$TEL_NUM**) does not successfully connect (after **$CALL_TRIES** tries), the phone number switches to the alternate number (**$ALT_TEL_NUM**), if available, for the next surfacing. If a communication session completes successfully on the alternate phone number, the phone number is switched back to the primary for the next surfacing. **NOTE**: This parameter is not adjustable from the cmdfile. The number can be edited either through the pdoscmds.bat file (see Appendix C, “Extended PicoDOS® Reference Manual, v66.07”, writenv on page 242), or through direct connection to Seaglider via the serial communications cable (see “Checking the primary and alternate phone numbers” on page 22).			
$TGT_AUTO_DEFAULT	A Boolean parameter. If set to 1, automatically updates the default target in NVRAM. If set to 0, does not update the default target in NVRAM.	0		

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Parameter	Definition	Nominal value	Min value	Max value
$TGT_DEFAULT_LAT	Floating point value (degrees decimal minutes) between -9000.000 and 9000.000. Together with **$TGT_DEFAULT_LON**, this parameter provides a default target location when the targets file cannot be read. For example, a latitude of 47 degrees 43.456 minutes would be input as 4743.456. Latitude values in the northern hemisphere will be positive values, while latitude values in the southern hemisphere will be negative values.	4212	-9000.00	9000.00
$TGT_DEFAULT_LON	Floating point value (degrees decimal minutes) between -18000.000 and 18000.000. Together with **$TGT_DEFAULT_LAT**, this parameter provides a default target location when the targets file cannot be read. For example, a longitude of -122 degrees 23.456 minutes would be input as -12223.456. Longitude values in the eastern hemisphere will be positive values, while longitude values in the western hemisphere will be negative values.	-7043	-18000.000	18000.000
$UNCOM_BLEED Set by manufacturer. Do not change.	The uncommanded change in A/D counts of VBD bleed that triggers the following actions in an attempt to save Seaglider: 1. Stop whatever motor is running (the assumption is that electrical noise from one of the motors causes the Skinner valve to open) and disable it. 2. Close the Skinner valve. 3. Enter the recovery state (go to the surface and call home).	60	0	400

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Parameter	Definition	Nominal value	Min value	Max value
$UPLOAD_DIVES_MAX	The maximum number of dives to upload at one surfacing. A value of -1 means upload all available dives that have not been previously uploaded. **NOTE:** If the **$RESEND_DIVE** command is issued in the pdoscmds.bat file, all available dives that have not been previously uploaded will be sent, as if the setting was -1. Also note that the setting will not be effective until the communications session after the one in which the parameter is first processed.	-1	-1	9999
$USE_BATHY	If **$USE_BATHY** is -4, search for an on-board bathymap.nnn appropriate for the current position of Seaglider. This would be the standard usage in operating areas covered by more than one map. If **$USE_BATHY** is a positive integer, then search for that particular on-board bathymap. If **$USE_BATHY** is 0, the feature is disabled and Seaglider either dives to **$D_TGT** or uses the on-board altimeter and its parameters to determine the appropriate depth at which to enter the apogee maneuver. **Examples** If **$USE_BATHY** = -4, then search all on-board bathymap.nnn files for one that covers the current Seaglider position. If **$USE_BATHY** = 0, then bathymetry maps are not used during the dive. If **$USE_BATHY** = 7, then use the bathymetry file called bathymap.007 to get **$D_GRID**. No other map will be used.	0	-4, 0	50
$VBD_BLEED_AD_RATE	The bleed rate in A/D counts per second that the code uses as the threshold for retries when bleeding. If the observed rate is less than this number, the bleed is stopped and restarted.	8	0	20

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Parameter	Definition	Nominal value	Min value	Max value
$VBD_CNV Set by manufacturer. Do not change.	VBD position conversion factor from A/D counts to cm^3. This is a constant determined by the geometry of the internal hydraulic fluid reservoir and the potentiometers. The sign is negative, meaning that the higher A/D counts reflect more oil in the internal reservoir, hence a less inflated external bladder, hence a lower Seaglider displacement, and thus a lower Seaglider buoyancy.	-0.245296		
$VBD_DBAND	VBD position deadband (cm^3).	2	0	10
$VBD_MAX Set by manufacturer. Do not change.	Variable Buoyancy Device (VBD) position (A/D counts) software limit when the internal reservoir is almost full (external bladder fully bled, minimum Seaglider buoyancy). The Seaglider operating software closes the VBD main bleed valve (Skinner valve) when this value is reached. **NOTE:** Value determined by the software maximum of the system. Obtain actual value from the vehicle's trim sheet.	4000		
$VBD_MAXERRORS	**CAUTION:** Loss of VBD function can result in the loss of Seaglider.			
	Number of VBD errors allowed before entering recovery phase. This is a critical error parameter.	1	0	5
$VBD_MIN Set by manufacturer. Do not change.	Variable Buoyancy Device (VBD) position (A/D counts) software limit when the internal reservoir is almost empty (external bladder fully pumped). The Seaglider operating software stops the VBD pump when this value is reached. **NOTE**: Value determined by the software minimum of the system. Obtain actual value from the vehicle's trim sheet.	460		

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Parameter	Definition	Nominal value	Min value	Max value
$VBD_PUMP_AD_RATE_APOGEE Set by manufacturer. Do not change.	The pump rate in A/D counts per second that the code uses as the threshold for retries when pumping at apogee. If the observed rate is less than this number, the pump is stopped and restarted. The glider continues to monitor speed and retry if speed dips below set value until the timeout limit is reached; then an error is declared.	4	1	6
$VBD_PUMP_AD_RATE_SURFACE Set by manufacturer. Do not change.	The pump rate in A/D counts per second that the code uses as the threshold for retries when pumping at the surface. If the observed rate is less than this number, the pump is stopped and restarted. The glider continues to monitor speed and retry if speed dips below set value until the timeout limit is reached, then an error is declared.	5	1	8
$VBD_TIMEOUT	The total time (seconds) allowed for any commanded change in VBD position. If the VBD does not achieve the desired position before **$VBD_TIMEOUT** seconds, a VBD error occurs.	720	120	900
$XPDR_DEVICE Set by manufacturer. Do not change.	A configuration value specifying the model of the attached device. These devices have dedicated hardware ports on all motherboard revisions and, as such, a port specification is not necessary. See $COMPASS_DEVICE,integer.	24	-1	1023
$XPDR_INHIBIT	A configuration value specifying the transponder inhibit time in hundreds of milliseconds. The inhibit time is the time after a transponder reply during which the transponder does not reply to subsequent interrogation. Shorter times mean the transponder can be interrogated more rapidly.	90	99 (9.9 seconds)	

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Parameter	Definition	Nominal value	Min value	Max value
$XPDR_VALID	A configuration value specifying the transponder interrogation validation sensitivity in units of 0.5 ms. Valid values are from 0 (no validation) to 6 (3 ms). The validation value is the total time over a 10 ms window following initial triggering that the detector circuit must remain triggered. Longer validation times reduce spurious interrogation replies, but could result in decreased range. A value of zero results in no validation.	2	0	6
$XPDR_PINGS	This is an output from the glider, representing the count of the number of times the glider transducer responded to an external stimulus at its frequency setting during a dive. During missions, this value should be zero. While an occasional ping is acceptable, frequent pings are not, as this activity consumes battery power. If excessive pings are seen in **$XPDR_PINGS**, tuning can be done using the **$XPDR_INHIBIT** and **$XPDR_VALID** parameters.	0	0	No limit

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CHAPTER 6 *Predeployment Tasks*

To get the most out of a Seaglider deployment, both duration and data-wise, Seaglider must be properly prepped in the lab, self checks must be thoroughly reviewed, and VBD, pitch and roll must be tuned when Seaglider is first deployed.

To achieve these goals a number of tasks must be completed by the pilot and the field team prior to releasing a Seaglider for a mission. These tasks include:

- Mission planning, including the modification of command, science and targets files
- Creating and loading of bathymetry files onto Seaglider, if desired.
- Autonomous self test at or close to the deployment site and time.
- Visual assessment, by the field team, of how Seaglider is riding in the water when it is first put in the water.
  - Approximately what angle is the nose pitch down in the water?
  - How much of the rudder or antenna is sticking out of the water?
- On land and in water testing of the transponder system.

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Mission planning

Mission planning is an important part of Seaglider piloting and the initial plan should be developed well before the vehicle is transported into the field for deployment. A basic understanding of the operation, strengths, and weaknesses of the Seaglider system is critical to planning effective science missions. The general idea is to go far and long by going slow — it's the square-law dependence of drag on velocity that gets you. “Half a knot on half a Watt” is the Seaglider motto.

The following sections give the operating limits of Seaglider.

Environment

The range of stratification in which a Seaglider can operate normally is constrained by the total amount of VBD change available and the amount of (negative) buoyancy required for the flight plan. Pilots and/or scientists directing the mission should determine the likely range of densities to be encountered on a proposed mission, and see if there is sufficient VBD range available to accommodate it. A typical Seaglider can operate over a density range of $10\sigma_T$. Compromises can be made by reducing maximum operating depth, at the expense of duration, or by reducing thrust at apogee, at the expense of horizontal speed.

The maximum sustained depth-averaged current that Seaglider can stem is 40 cm/s, or 0.8 knots. For a few individual dives it can go as fast as 50 cm/s. That performance requires ballasting for 350 cc of negative displacement and specifying vertical velocities of almost 20 cm/s. Dives to 1000m last about three hours in that case, and total mission length is on the order of six weeks. Remember that it is the average current over the full depth of the profile/dive that counts.

Surface currents can also be a problem, especially when doing shallow dives (see below). Plans for crossing strong currents, such as the Kuroshio or Gulf Stream, should be carefully considered, and contain both return (upstream) and bail-out plans.

Endurance

Total endurance, is dependent on many factors, including depth of dive, vertical velocity, density stratification, and communications. The 24 V lithium primary battery pack services the pump, mass shifter and the modem. The 10 V lithium primary battery pack services the science sensors. Based on the way you’re operating the vehicle either battery pack can be the limiting factor. When you’re operating in shallow water resulting in frequent VBD pumping the 24 V battery will likely run out first. When you’re operating in deeper water doing very little science sensor sampling the 24 V will still likely run out first. When you’re operating in shallow or deep water and you’re sampling the science sensors heavily, the 10 V battery will run out first.

Seaglider has completed open-ocean missions more than nine months long, in conditions of small stratification (NE Pacific) where power conservation was the guiding factor. Missions north of Oahu (Hawaiian Ocean Time Series Station) typically lasted four months, due to stratification and the science requirement to resolve tides. Seaglider missions in the highly stratified Fjord -estuary of the Puget Sound are typically planned for only a few months.

Using the information gathered on the environment in the study area (depth, stratification, currents), as well as how long Seaglider is to be deployed, what horizontal distance it should cover in that time frame and what the scientific objectives are, determines overall mission length.

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The VBD sub-system is the predominant energy consumer. Proper system trimming will allow for greatest energy efficiency.

Seaglider flies half a knot on half a watt (½ knot ~ 25 cm/s ~ 1 km/hr).

Depth and efficiency

Seaglider is least efficient operating in shallow water and most efficient in deep (up to 1000 m) water. The practical shallow water limit is about 50 m. It is hard to make progress toward a waypoint in water shallower than that, for three main reasons: turn radius, pump time, and surface time. Seaglider system's turning radius (a few tens of meters at typical 25 cm/s horizontal speeds) is such that a significant portion of a shallow-water dive can be spent turning onto the desired course. For more information, see "Bathymetry" on page 41.

Finally, the time on the surface can be a significant percentage of the dive time, and if surface currents or winds are adverse, Seaglider can easily lose as much distance toward a waypoint while on the surface as it gains on the dive. Standard guidelines are to operate deeper than 200 m on offshore (deepwater) missions, and to try to stay deeper than 50 m on coastal or estuarine missions.

Uncontrollable environmental factors

Stratification. The number of density layers and their magnitude in the water column will affect Seaglider's power consumption. The more density layers and the larger the density change present that Seaglider has to overcome, the more energy it will use when pumping to achieve the needed buoyancy.

Temperature. Operating in colder environments can reduce the total amount of energy available from the batteries.

Ocean currents. An environment with strong ocean currents (surface or subsurface) opposing the travel direction of the glider will necessitate more glider thrust. More thrust is supplied by more bleeding of oil during the dive. The bleeding leads to more pumping at apogee to make the glider buoyant enough to climb.

Pilot controllable factors

Seaglider trimming. A well trimmed Seaglider will require less corrective action while in flight and conserve both the 10V and 24V power supplies. The primary piloting parameters below will have the greatest impact on power consumption.

$D_TGT + $T_DIVE. The ratio of $D_TGT and $T_DIVE controls the speed at which the Seaglider dives and climbs. Adjusting the ratio to perform slower dives results in longer dive time and therefore increases the amount of time between apogee and surface VBD pumping maneuvers giving more operational time relative to energy use.

$MAX_BUOY. Decreasing the amount of oil used to for thrust decreases the overall VBD usage and conserves the energy stored in the 24V battery.

$SM_CC. Decreasing the amount of oil used for the surface maneuver decreases the overall VBD usage and conserves the energy stored in the 24V battery.

$CALL_N_DIVES. Skipping Iridium transmissions during specified dives conserves the energy stored in the 24V battery.

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$CAPUPLOAD. Turning off the transmission of the .cap file conserves the energy stored in the 24V battery. This file, which contains a detailed record of the entire dive, can be quite large, causing the glider to remain at the surface for an extended period of time while its contents are transferred to the Basestation via Iridium.

G&C interval. Increasing the G&C interval value (in the science file) decreases the frequency at which the guidance and control is checked conserving the energy stored in the 10V battery resulting in fewer attitude and buoyancy corrections which conserves the energy in the 24V battery.

Science file. Increasing the number of seconds between science sensor samples will decrease the frequency at which the sensors are powered on and conserve the energy stored in the 10V battery.

Remove all unneeded commands. Removing all unneeded command files from the basestation will decrease the amount of data transferred and conserve the energy stored in the 24V battery.

For mission planning on deep dives, iRobot recommends using the information in Table 6-1 to estimate energy usage.

Table 6-1. Energy budget for a 1000-meter dive

Seaglider subsystem	Energy consumed	Battery used (%)
Pump*	-9 kJ	70
Computer	-2 kJ	15
Sensors	-1 kJ	7
Telemetry	-1 kJ	7
Total	-13 kJ	100

NOTE:* For a deep, slow dive of 200 cc of thrust and stratification of 150 cc

Mission duration examples

The following comparison shows expected endurance for standard and enhanced buoyancy engine gliders carrying the same science sensor payload.

Conditional assumptions for all examples in Table 6-2

MAX_BUOY=150

SM_CC=350

Calls per dive = 1.5

10 cm/sec vertical velocity

5% of packs used at beginning of mission

5% of packs left at end of mission

No capture files transmitted

Call in after every dive

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Above 100 m sample dissolved oxygen, WetLabs, and Conductivity & Temperature Sail every 10 seconds, Guidance & Control Interval = 60.

Between 100 m-500 m sample Conductivity & Temperature Sail every 10 seconds, and WetLabs and Dissolved Oxygen every 30 seconds, Guidance & Control interval = 180.

Between 500 m-1000 m sample Conductivity & Temperature every 10 seconds, and WetLabs and Dissolved Oxygen every 60 seconds, Guidance & Control interval = 180

Table 6-2. Endurance examples based on specific configurations

Sensors	Buoyancy engine option	100 m duration (days)	100 m limiter	500 m duration (days)	500 m limiter	1000 m duration (days)	1000 m limiter
Seabird Conductivity & Temperature Sail, WetLabs Sensor	Standard buoyancy engine	55	24V	124	10V	206	10V
Seabird Conductivity & Temperature Sail, WetLabs Sensor	Enhanced buoyancy engine	69	24V	121	24V	184	24V
Seabird Conductivity & Temperature Sail, Seabird Dissolved Oxygen Sensor	Standard buoyancy engine	55	24V	153	10V & 24V	221	24V
Seabird Conductivity & Temperature Sail, Seabird Dissolved Oxygen Sensor	Enhanced buoyancy engine	69	24V	121	24V	183	24V
Glider Payload Conductivity, Temperature & Depth Sensor, WetLabs Sensor	Standard buoyancy engine	54	24V	96	10V	118	10V
Glider Payload Conductivity, Temperature & Depth Sensor, WetLabs Sensor	Enhanced buoyancy engine	68	24V	96	10V	118	10V

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cmdfile edits

The starting point for making edits to the cmdfile is the log files generated by the simulated dives. The log files list all parameters and the value assigned to each.

1. Open the last simulated dive's log file and using the "Alphabetized parameters" on page 56, go through ***every*** parameter and see if all are set correctly for the upcoming mission.

   For example, the initial dive should be relatively shallow (~45m) to check the initial positions of system centerpoints. So **$D_TGT** should be set to **$D_TGT,45**. Correspondingly, the desired vertical velocity of the initial dives is usually 10cm/s so **$T_DIVE** should be set to **$T_DIVE,15**. **$T_MISSION** should be set to **$T_MISSION,25**.

   If Seaglider is to fly from waypoint to waypoint rather than by heading, **$HEADING** should be **$HEADING,-1**. **$MAX_BUOY** and **$SM_CC** settings are environment dependent and should initially be set conservatively. **$MAX_BUOY,150** and **$SM_CC** near maximum.
2. Check **$C_VBD**, **$C_PITCH**, **$C_ROLL_DIVE** and **$C_ROLL_CLIMB** values against those listed in the Cal sheet of the notebook that came with Seaglider.
3. Turn on the **$USE_BATHY** feature if bathmetric maps are to be used.
4. Turn on the Kalman filter, if that feature is desired.
5. Check that **$T_RSLEEP,3** has been set.
6. Make sure that the last line of the command file is initially **$QUIT.**

   This holds Seaglider at the surface when it is first put in the water for the deployment. If the command **$RESUME** is inadvertently left in place, Seaglider will "dive" as soon as it is given permission to launch and you will not know exactly what state it will be in when it gets in the water. Seaglider needs to remain at the surface when it is first put in the water so that the transponder and communication checks can be completed and how Seaglider is sitting in the water can be evaluated.

targets edits

Next, determine what path Seaglider should fly during its mission. Again, this can be edited as the mission progresses. When the waypoints have been determined, edit the targets file with this information. Table shows an example of a targets file and a description of each column..

Table 6-3. Sample of North Carolina coast targets

/ Sample North Carolina Coast targets				
NCSPONE	lat=3357.4	lon=-7623.5	radius=200	goto=WPONE
WPONE	lat=3356.0	lon=-7625.2	radius=200	goto=WPTWO
WPTWO	lat=3353.9	lon=-7625.2	radius=200	goto=WPTHREE
WPTHREE	lat=3352.2	lon=-7621.4	radius=200	goto=WPFOUR
WPFOUR	lat=3356.6	lon=-7623.8	radius=200	goto=NCSPONE

- Column 1: Name of the waypoint
- Column 2: Latitude of waypoint in degrees, decimal minutes (no spaces between degrees and minutes)
- Column 3: Longitude of waypoint in degrees, decimal minutes

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- Column 4: Distance in meters Seaglider can be from the waypoint and still consider having reached the waypoint
- Column 5: Name of the next waypoint to go to after it has reached the present waypoint

For new missions, Seaglider heads to the first waypoint listed, in this case the one called NCSPONE. To change the waypoints file during a mission the pilot can upload a new waypoints file. However, use caution when doing this. If an active target name from the old targets file is in the new targets file, Seaglider retains that active target. If an active target is not in the new targets file, then Seaglider goes to the first target in the list.

If the pilot wants to change the waypoint, Seaglider is going to in the targets file that is loaded on Seaglider (for example, Seaglider is heading to NCSPONE in the example above and the pilot wants Seaglider to head to WPTWO instead) the pilot sends this change to Seaglider via the pdoscmds.bat file. For the correct syntax to make the change, see Appendix C, “Extended PicoDOS® Reference Manual, v66.07” on page 233.

If there is no valid targets file on Seaglider, it uses the default target (**$TGT_AUTO_DEFAULT, $TGT_DEFAULT_LAT, $TGT_DEFAULT_LON**). It is highly recommended that you enter the latitude and longitude coordinates of a location as DEFAULT where you can recover Seaglider in the event that it loses or cannot read its targets file.

Science sensors

Seaglider supports two science sensor interfaces, Ordinary Serial Interface (OSI) and Autonomous Logger Interface (ALI), to allow a variety of sensors to be connected to the vehicle via the serial ports.

Ordinary Serial Interface (OSI) is a .cnf file configurable serial sensor interface that allows new instruments to be added to the glider without writing new binary drivers or modifying source code. OSI is used exclusively for sensors without the ability to log data to an internal file system.

Note that OSI devices can be configured either through the provided .cnf files or via pre-established options available in the configuration menus described in Appendix F.

iRobot currently provides .cnf files for the following OSI sensors: Biospherical PAR, WET Labs (BBFL2, BB2FL, BB3, and FL3), Aanderaa Dissolved Oxygen, Free Flowed Sea-Bird Dissolved Oxygen, and CT-Sail.

Autonomous Logger Interface (ALI)

ALI is a .cnf file configurable serial sensor interface that allows new instruments to be added to the glider without writing new binary drivers or modifying source code. ALI is used exclusively for sensors with the ability to log data to an internal file system.

iRobot currently provides .cnf files for the following ALI sensor: Sea-Bird GPCTD, Pumped Sea-Bird Dissolved Oxygen, Current Profiler, and Echo Sounder.

All Autonomous Logger Interface (ALI) devices recognize five cmdfile parameters: xx = the prefix for a given sensor. Example for the GPCTD, the prefix = PC.

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science edits

Control of the sampling and depth intervals for the OSI sensors, to meet the science requirements of the mision, are specified in the science file. Note that ALI sensors (described in the previous section) are not controlled via the science file. For information on controlling ALI sensors, see Chapter 9, “Files for Operations” on page 171.

The practical lower limit on sampling is 4 seconds. If only the conductivity and temperature sensors are sampled, it is possible to sample every 4 seconds, but with the oxygen and BBFL2 or BB2FL optical sensors also being sampled, 5 seconds is the lower limit. The science file also provides the ability to turn off sensors, or only energize them every *nth* sample, in a given depth range (or ranges). Table 6-4 shows an example science file for Seaglider with sensors CT, WET Labs BB2FL-VMT, SBE-43 DO.

Table 6-4. Sample science for North Carolina coast

/depth	time	sample	gcint
50	5	111	30
200	5	121	60
300	5	103	120

- Column 1: The bottom of the depth bin in meters for that sampling protocol
- Column 2: Base sampling interval in seconds
- Column 3: The order of the sensors in the science file is defined by what port they are each configured to. This information is in the .cap file of the respective glider’s self test. For example, from the following .cap file output:

  59.976,SUSR,N,---- Reporting hardware configuration ----

  60.110,SUSR,N,Sensor in slot 1 is SBE_CT on port 2, TPU04/TPU05, nominally 'CT'

  60.275,SUSR,N,Sensor in slot 2 is WL_BB2FLVMT on port 3, TPU06/TPU07, nominally 'Optics 1'

  60.455,SUSR,N,Sensor in slot 3 is SBE_O2 on port 4, TPU08/TPU09, nominally 'O2'

  The first multiplier would be applied to the CT sail, the second multiplier to the WET Labs BB2FL and the third multiplier to the SBE DO.
- Column 4: Guidance and Control (G&C) sampling interval in seconds

The science sampling works as follows:

For the first row of sampling protocol, sampling in depths from 0-50m, each of the sensors is sampled once every 5 seconds – multiply the 5 in column 2 by the first digit (1) in column 3 for CT, by the second digit (1) in column 3 for SBE-43F and by the third digit (1) in column 3 for the WET Labs sensor. G&C sampling between 0 and 50m occurs once every 30 seconds.

Sampling Rate = Sample time x respective sensor sample interval

Where:

- Sample time = value in column 2
- CT interval = 1st digit of the value in column 3
- WET Labs interval = 3rd digit of value in column 3

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- SBE-43 interval = 2nd digit of value in column 3

For the second row of sampling protocol, depths between 50 and 200m, the CT and WET Labs sensors are sampled once every 5 seconds – multiply the 5 in column 2 by the first digit in column three for the CT sensor and multiply the 5 in column 2 by the third digit in column three for the WET Labs sensor. The SBE-43F oxygen sensor is sampled once every 10 seconds – multiply the 5 in column 2 by the second digit in column 3. The G&C sampling occurs once every 60 seconds.

For depths below 300m, Seaglider continues to use this sampling routine. Note that the bound on depth interval is dependent on pressure sensor sampling and Seaglider vertical velocity. The pressure is only sampled at the base interval, so if that is large and Seaglider is going fast, the switch to the next regime may be deeper/shallower than expected. Choices made in the science sampling have an impact on the energy use of Seaglider, especially the 10V battery pack. More samples and shorter G&C intervals use more processor and sensor power than do fewer samples and longer G&C intervals.

Point to point variability may be seen in the WET Labs data due to the differences in sampling frequency between the WET Labs puck and the glider. The WET Labs puck samples at 1Hz (one sample/second). The default sample averaging by the puck is also once/second. However, the glider sampling frequency is no faster than 1/4Hz (once every 4 seconds) and is dependent on the number of sensors being sampled. The frequency that the glider interrogates the WET Labs puck, as well as any other science sensor, for a data point is set by the user in the science file and is often between 1/5Hz (once every 5 seconds) and 1/10Hz (once every 10 seconds). This means that only 1/5th to 1/10th of the WET Labs data samples are recorded by the glider which can accentuate any point to point variation in the WET Labs data.

Bathymetric files

Map files provide Seaglider with geographic environmental information, specifically bathymetry about a given region of the ocean. Seaglider can carry up to 999 bathymetry maps (the files are named bathymap.nnn, where .nnn is the map number), but in practice far fewer are typically on board. These maps are not required for Seagliders to fly, but provide a low energy means to determine apogee depth. Note that the values in the bathymap files represent the depth at which Seaglider starts its apogee maneuver, NOT the actual bottom depth.

After the files are generated, load them onto Seaglider's flashcard following this procedure:

1. Connect the laptop to Seaglider via the communication cable.
2. Turn on the laptop and start a screen capture or log file.
3. Wand on Seaglider.
4. Press Enter when Seaglider output appears on the laptop.
5. Set the date and time.
6. Select appropriate power source.
7. Type 4 (pdos) from the Main Menu, and then press Enter.
8. At the PicoDOS prompt, type:

   xr bathymap.xxx

   where xxx is the number (from 001-999) of the bathymap.

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10. Select the desired bathymap file.

    The bathymap file is downloaded to Seaglider. The watchdog timer may cause Seaglider to reboot if more than 10 minutes are spent in PicoDOS. If this happens and you are not finished loading bathymap files, repeat steps 8-10.

11. To exit from PicoDOS, type `quit` and press Enter.

.pagers file

For directions on setting up a .pagers file, see Chapter 7, “Prelaunch Procedures” on page 133.

.mailer file

This file controls the sending of data products created during basestation processing via email. Mail is formatted as a MIME document and sent via SMTP. Each line of this file has the format:

smtp_mail_address[,body|msgperfile|kkyy_subject|gzip] [,[eng| log| pro| bpo| csv| asc| cap| comm| dn_kkyy| up_kkyy| nc| mission_ts| mission_pro]+] | ,all

where:

smtp_mail_address - a valid smtp mail address - gliderpilot@iRobot.com

For example:

- body - send files in the body of the message, instead as attachments (default). Incompatible with gzip, nc, mission_ts and mission_pro
- msgperfile - send each file in its own message, instead of sending all files that have been
- newly created in a single message (default)
- kkyy_subject - Use the navy specified 'XBTDATA' subject line, instead of a more informative subject (default)
- gzip - compress all files before sending
- eng, log, pro, bpo, csv, asc, cap , dn_kkyy, up_kkyy, nc - send any newly created files of the specified extension
- comm - send the comm.log file
- mission_ts, mission_pro - send the mission timeseries or mission profile, if they have been updated on the processing
- all - send all the newly created or updated files

Examples

- Send NAVO kkyy files:
  `kkyyuser@navo.navy.mil,msgperfile,body,kkyy_subject,dn_kkyy,up_kkyy`
- Send out the typical per-dive files:
  `someone@apl.washington.edu,gzip,log,eng,cap,nc,comm`
- Send a collaborator the update mission profile (be careful, this can be a big file):
  `someone@u.washington.edu,gzip,mission_pro`

NOTE: To comment out a line in the file, add a number sign (#) at the beginning o f the line.

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Transporting Seaglider to the field

When deployment time is close, transport Seaglider to the field. If it is a short trip, Seaglider may be able to be transported in its cradle. Remove the antenna from the aft end of Seaglider, leaving the cables attached (Figure 6-1). It may also be necessary to remove the wings.

If getting Seaglider to the field involves a longer trip and/or commercial shipping, put Seaglider in travel mode and use the shipping crate.

Detaching the antenna mast from aft fairing

1. Remove the rudder screws.
2. Slide the antenna mast and rudder boot out of the aft fairing (can best be facilitated if the rudder section is outside of the cradle as in Figure 6-1).
3. Fold the antenna mast back next to the Seaglider.

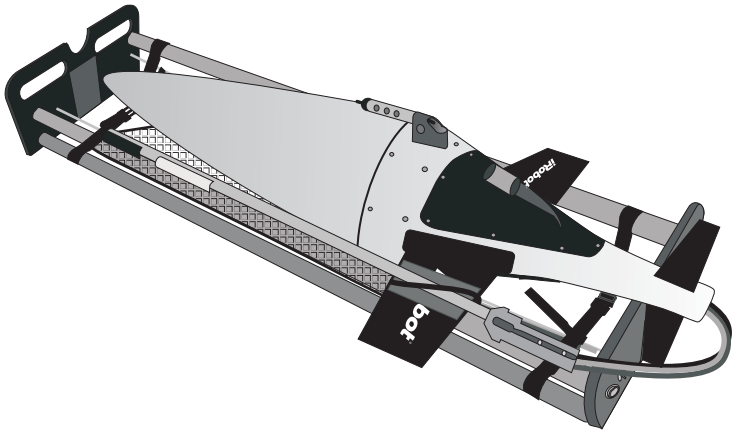


Figure 6-1. Seaglider with antenna mast removed from the aft fairing

Putting Seaglider in travel mode

When you put Seaglider in travel mode, you bleed most of the hydraulic oil from the external bladder to the internal reservoir, making it safe for travel, and move the battery to its most stable position. Seaglider does not have to be outside, nor does the antenna have to be fully installed.

1. Connect Seaglider to the laptop via the communication cable.
2. Turn on the laptop and start the terminal emulation program and a screen capture or log file.
3. Wand on Seaglider. When output from Seaglider appears on the computer screen press Enter within one minute.
4. Accept the default when prompted for DATE and TIME.
5. When queried “Are you running on external (bench) power?” answer Yes (type `Y`) or No (type `N`), depending on how Seaglider is being powered.
6. Go to the Main menu (Figure 6-2).

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7. At the Main menu, select **2**: Hardware Tests & Monitoring, and press Enter.

```
------ Hardware Menu ------
*Motors and VBD
     1 [pitch   ]  Pitch control
     2 [roll    ]  Roll control
     3 [vbd     ]  VBD control
     4 [pressure]  Pressure sensor
     5 [compass ]  Compass (tcm2)
     6 [gps     ]  GPS
     7 [modem   ]  Modem (xmodem mode)
     8 [intpress]  Internal pressure
     9 [altim   ]  Altimeter
*Sensors
    10 [ct      ]  C,T sensors
    11 [nullct  ]  NULL C,T sensors
    12 [o2      ]  O2 sensor
    13 [wetlabs ]  WETLabs VSF & fluorometer
    14 [par     ]  QSP 2150 PAR sensor
    15 [optode  ]  Optode
*Other
    16 [batt    ]  Batteries and fuel gauges
    17 [lowlevel]  Low-level hardware (IO,A-D,CF)
    18 [misc    ]  Miscellaneous (travel, timeouts, date/time)
    19 [develop ]  Developer tests
    CR)  Return to previous
Enter selection (1-19,CR): 18 ———— Step 8
```

Figure 6-2. Travel mode menu – 1

8. Type **18** ([misc] Miscellaneous (travel, timeouts, date/time)), and press Enter.
9. When **Miscellaneous Hardware Functions** appears, type **1** ([Travel] Prepare for travel (Figure 6-3)). Seaglider then bleeds the oil from the external bladder into the internal resevoir.

```
------ Miscellaneous hardware functions ------
     1 [travel  ]  Prepare for travel
     2 [iotime  ]  Change user IO timeout
     3 [timeout ]  Change watchdog time (mins)
     4 [date    ]  Read/set time-of-day
     5 [zerost  ]  Reset self-test counter to zero
     6 [fault   ]  Force a fault - WARNING, CRASHES to TOM8!!!!
     7 [dump    ]  Dump captured registers
    CR)  Return to previous
Enter selection (1-7,CR): 1 ———— Step 9
Bleeding down...
1314.122,HVBD,N,Bleed commanded from 405.96 cc (1755) to 15.21 cc (3
1315.321,HVBD,N,403.5 cc (ad: 1765 [1772, 1771]) ...................
1326.521,HVBD,N,336.1 cc (ad: 2040 [2027, 2065]) ...................
1337.796,HVBD,N,271.5 cc (ad: 2303 [2304, 2310]) .......
```

Figure 6-3. Travel mode menu – 2

10. When the “good to go!” message appears, wand Seaglider off.

    Ensure that Seaglider is off by repeatedly pressing Enter on the laptop keyboard. If there is no response, Seaglider is turned off.

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Packing Seaglider in its shipping case

1. Remove the screws holding the rudder in place and remove the rudder. Store the screws in the spare parts kit. Place the rudder in its compartment in the shipping case.
2. Slide the antenna mast and rudder boot out of the aft fairing (can best be facilitated if the rudder section is outside of the cradle (see Figure 6-1).
3. Fold the antenna mast back next to the Seaglider.
4. Remove the wings.
5. Store the screws in the spare parts kit.
6. Place the wings in their compartment in the shipping case.
7. Put Seaglider in the shipping crate, securing the antenna. Be careful not to damage the antenna or stress the cables that connect the antenna to the glider.
8. Put the laptop, communication cable, notebook, spare parts kit and anything else that originally came out of the shipping case back in it.

Shipping Seaglider

Lithium battery shipments are controlled by the Department of Transportation (DOT), International Civil Aviation Organization (ICAO), and the International Air Transport Association (IATA). Under the US DOT regulations, please review requirements under 49 CFR 172.101 and Special Provisions 29, 188, 189, 190, A54, A55, A101, and A104 and packing instruction 49 CFR 173.185. Under the IATA regulations, please review 4.2 List of Dangerous Goods and Special Provision A48, A88, A99, A154, A164 and Packing Instruction 968, 969, or 970.

Assembling Seaglider

Re-assemble Seaglider, following the instructions in “Assembling the Seaglider” on page 14.

Performing the interactive self test

Run the interactive self test “Interactive self test” on page 133. This can be done on shore or at sea. When Seaglider calls into the basestation, it should pick up the cmdfile, science, and targets files that you edited (see “cmdfile edits” on page 112, “targets edits” on page 112, and “science edits” on page 114).

At the conclusion of the self test, if it passed, the field team stands by, laptop still connected to Seaglider, while the pilot reviews all of the files that were generated and makes sure that all systems are functioning as expected giving permission to start the Sea Launch sequence. The field team needs to be patient as this process can take 15 minutes. The pilot needs to review the following:

.cap file. (ptnnnxxxx.cap; where p=processed, t=self test, nnn=Seaglider number, xxxx=self test number)

- Look for errors and warnings.
- Were file transfers successful?
- Was a GPS fix obtained?
- Did the motors move as expected?

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.eng file. (ptnnnxxxx.eng; where p=processed, t=self test, nnn=Seaglider number, xxxx=self test number)

- Check the science data as best as possible.
- Does the file header line match the sensors that are installed?
- Are the temperature values from the CT sensor realistic?
- Are the conductivity values very close to zero?
- There should be some oxygen trapped in the DO sensor. Is there a dissolved oxygen reading greater than zero?
- For the optical sensors, are there no NANs and is the data expected data?
- Are the reference values the expected reference value and are they in the correct columns?

.log file. (ptnnnxxxx.log; where p=processed, t=self test, nnn=Seaglider number, xxxx=self test number)

- Check the list of parameters and the value assigned to each.
- Do the parameter values look okay?

If all of the data in the files looks good, the pilot gives the field team permission to Launch.

Communication messages

When attempting to make a phone call with the Seaglider, it is very common to see different types of error messages returned. Table 6-5 shows some commonly returned messages along with their meaning.

Table 6-5. Error messages for phone calls

Error message	Description
NO CARRIER	Phone call has dropped. The modem returns this string when a call has ended.
REGISTRATION CHECK FAILED	The AT+CREG? command has returned that it is not registered on the satellite network.
	This is not a fatal error; the glider will continue with operations, skipping the geo-registration. If the Seaglider is still able to make a phone call, this is not a major issue; in order to make a phone call, you must be registered on the satellite network.
UNABLE TO LOGIN	There was a problem logging into the basestation.
	This could be due to corruption in the communications channel; a phone call that dropped prematurely; the Seaglider may be commissioned incorrectly; or the password might be incorrect.
NO REPSONSE TO INITIAL AT ATTEMPTS	The Seaglider determines if the modem is awake and powered on by sending “AT” and then expecting “OK” in response. If it does not receive the AT, a failure occurs.
	This can indicate a modem is exhibiting faulty behavior, the Seaglider is commissioned incorrectly, or the password is incorrect.

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Table 6-5. Error messages for phone calls (Continued)

Error message	Description
NO LOGIN: PROMPT DETECTED	See UNABLE TO LOGIN (excludes dropped calls).
BASESTATION NOT READY TO RECEIVE	See UNABLE TO LOGIN (excludes Seaglider may be commissioned incorrectly and password might be incorrect)

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Final launch procedure

1. At the Main Menu, type **5** (Pre-Launch), and then press Enter (Figure 6-4).

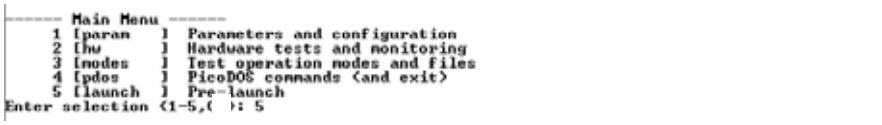

------ Main Menu ------
1 [param] Parameters and configuration
2 [hw] Hardware tests and monitoring
3 [modes] Test operation modes and files
4 [pdos] PicoDOS commands (and exit)
5 [launch] Pre-launch
Enter selection (1-5,( ): 5

Figure 6-4. Pre-Launch

2. Type **7** (Sea Launch!), and then press Enter.
3. At the prompt, "Can the antenna be used for GPS and communications? [Y]," press Enter to accept the default (Y) (Figure 6-5).

   Seaglider then resets **$SIM_PITCH** and **$SIM_W** to 0, and removes old data and log files from the persistor CF2 flashcard.

```
------ Launch Menu ------
     1 [scene   ]  Set scenario mode
     2 [selftest]  Perform interactive self test
     3 [autotest]  Perform autonomous self test
     4 [uploadst]  Upload self-test results
     5 [reset   ]  Reset dive/run number
     6 [test    ]  Test Launch!
     7 [sea     ]  Sea Launch!
    CR)  Return to previous
Enter selection (1-7,CR): 7 ———————— Step 2

Can the antenna be used for GPS and communications? [Y] y ——— Step 3
1161.831,SPOWER,N,All devices are off.
1161.882,SUSR,N,Resetting $SIM_W and $SIM_PITCH to 0.0
1161.952,HTT8,N,Updating parameter $SIM_W to 0
1162.013,HTT8,N,Updating parameter $SIM_PITCH to 0
1162.103,HTT8,N,Writing NVRAM...done.
1169.577,SUSR,N,Removing old data and log files
Deleting ST0032DU.X00...
Deleting ST0032KZ.X...
Deleting ST0032LU.X00...
Deleting ST0032LU.X01...
```

Figure 6-5. Sea Launch

4. At the prompt, "New telnum? [value]," if the value shown is for the current telnum is correct (check with pilot if necessary), press Enter. Otherwise, type a *value* and press Enter. For the correct phone number format, see page 22.
5. At the prompt, "New altnum? [value]," if the value shown is for the current altnum is correct (check with pilot if necessary), press Enter. Otherwise, type a *value* and press Enter.

   For the correct phone number format, see page 22.
6. Seaglider tries to obtain a gps fix. The message "DeviceUp: No data from device Garmin_GPS 15H on TPUO after 1500 msecs!" is to be expected. The GPS unit on average needs 4 seconds after startup to obtain a fix and output data. The value 1500 msecs is hard coded into the software and changing it requires a re-compile of the code. The response time will be increased from 1500 msec on the next code release.

   Seaglider prompts "Allow the GPS to acquire the almanac? [N]" (Figure 6-6).

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7. **For Seagliders with ID numbers 515 and lower:** Type Y and then press Enter.

   Seaglider acquires the almanac, writes the results to NVRAM and obtains a gps fix. Seaglider obtains a GPS fix, updates the almanacs and synchronizes the time onboard Seaglider.

   For Seagliders with ID numbers 516 and higher: The Garmin next generation GPS unit is installed. It has the same functionality as the unit installed in earlier Seaglider units, however, now the firmware automatically acquires the almanacs. Therefore when prompted, "Allow the GPS to acquire the almanac? [N]," press Enter to accept the default 'No.'

   If you type Y the output looks very different from the output of the earlier model to the point of looking erroneous. If the unit is successfully acquiring GPS fixes it is functioning properly.

```
1238.258,HGPS,N,Obtaining GPS fix
1239.811,HGPS,N,DeviceUp: No data from device Garmin_GPS15H on TPU0 after 1500 msecs!
1239.927,HTT8,N,Updating parameter $T_GPS_CHARGE to -10322.999
Allow the GPS to acquire the almanac? [N] y
1245.944,HTT8,N,Updating parameter $T_GPS_ALMANAC to 12.5
1246.041,HTT8,N,Writing NVRAM...done.
1255.427,HGPS,N,Acquiring GPS almanac for 12.50 minutes ...
1255.599,HGPS,N,
Checking almanac...
1255.944,HGPS,N,satellite 2 almanac is 6 weeks old
1256.135,HGPS,N,satellite 3 almanac is 6 weeks old
1256.325,HGPS,N,satellite 4 almanac is 6 weeks old
1256.516,HGPS,N,satellite 5 almanac is 6 weeks old
1256.706,HGPS,N,satellite 6 almanac is 6 weeks old
1257.342,HGPS,N,satellite 7 almanac is 6 weeks old
1257.534,HGPS,N,satellite 8 almanac is 6 weeks old
1257.724,HGPS,N,satellite 9 almanac is 0 weeks old
1257.916,HGPS,N,satellite 10 almanac is 5 weeks old
1258.110,HGPS,N,satellite 11 almanac is 0 weeks old
1258.301,HGPS,N,satellite 12 almanac is 0 weeks old
1258.492,HGPS,N,satellite 13 almanac is 6 weeks old
1258.682,HGPS,N,satellite 14 almanac is 0 weeks old
1258.874,HGPS,N,satellite 15 almanac is 0 weeks old
1260.089,HGPS,N,satellite 16 almanac is 0 weeks old
1276.341,HGPS,N,Almanac updated (almanac status check ok)...
1276.418,HTT8,N,Updating parameter $T_GPS_ALMANAC to 0
1276.513,HTT8,N,Writing NVRAM...done.
1286.299,HGPS,N,Acquiring GPS fix ...
1287.370,HGPS,N,AAAAAA
1294.001,HGPS,N,sync sentence $GPRMC,230737,A,3556.3475,N,07854.1011,W,000.0,000.0,200110,008.7,W*76
1294.127,HGPS,N,set 2010/01/20 23:07:38
1294.422,HGPS,N,confirm $GPRMC,230738,A,3556.3476,N,07854.1012,W,000.0,000.0,200110,008.7,W*79
1294.563,HGPS,N,200110, 230736, 3556.347412, -7854.101074 1.500000 1/6 seconds
1295.173,HTT8,N,Updating parameter $T_GPS_CHARGE to -10323.622
```

Step 7

Figure 6-6. GPS fix

8. Seaglider calls the basestation and uploads the cmdfile and if present the science, targets and pdoscmds.bat files, and downloads the files generated by the sea launch routine.
9. Make sure that the directive **$QUIT** is the last line of the cmdfile.

   Field team:

   Seaglider gets a GPS fix, then call the basestation. After it logs out, it asks the operator, "Do you have permission to launch?"

   - Call the pilot.
   - Standby while the pilot checks the pnnn000.prm (p=processed, nnn=Seaglider number, 0000=dive 0) file. The field team cannot launch until the pilot grants the permission to launch!

   Pilot:

   - The pilot MUST check the .prm file completely before continuing. The .prm file starts with a section captured from the end of the self test. You can see the statement the field team saw on their laptop connected to Seaglider. Next, it shows a list of every parameter and the value assigned to it. Are ALL of the parameters set correctly? Were **$SIM_PITCH** and **$SIM_W** reset to 0?
   - If all looks good to the pilot, the pilot tells the Field Team that they have permission to launch Seaglider.

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- If any changes must be made to parameter values, do so in the cmdfile. If the pilot feels confident that the necessary changes have been made to the cmdfile, the pilot grants permission to the field team to launch. The updated cmdfile is transferred to Seaglider at the beginning of the launch sequence. Watch the file transfer in the ***comm.log*** file (tail –f comm.log).
- Were file transfers successful?
- Was a GPS fix obtained?
- Is the **$QUIT** directive at the end of the command file that was sent?

10. When the pilot gives permission to launch, and the field team types **Y**, Seaglider autonomous program takes over (Figure 6-7). It puts Seaglider in surface position (rolled to neutral, pitched fully forward, pumped to **$SM_CC**, typically maximum VBD for launch) and enters a normal surface phase: acquiring GPS1 and initiating a communication session via Iridium satellite telephone.

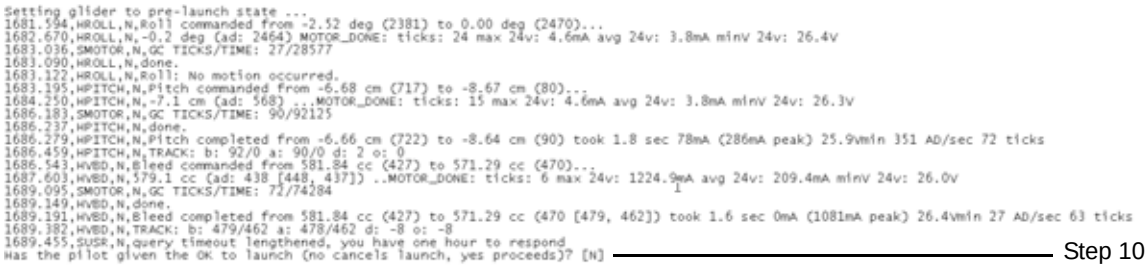

Setting glider to pre-launch state ...
1681.594,HROLL,N,Roll commanded from -2.52 deg (2381) to 0.00 deg (2470)...
1682.670,HROLL,N,-0.2 deg (ad: 2464) MOTOR_DONE: ticks: 24 max 24v: 4.6mA avg 24v: 3.8mA minV 24v: 26.4v
1683.036,SMOTOR,N,GC TICKS/TIME: 27/28577
1683.090,HROLL,N,done.
1683.122,HROLL,N,Roll: No motion occurred.
1683.195,HPITCH,N,Pitch commanded from -6.68 cm (717) to -8.67 cm (80)...
1684.250,HPITCH,N,-7.1 cm (ad: 568) ...MOTOR_DONE: ticks: 15 max 24v: 4.6mA avg 24v: 3.8mA minV 24v: 26.3v
1686.183,SMOTOR,N,GC TICKS/TIME: 90/92125
1686.237,HPITCH,N,done.
1686.279,HPITCH,N,Pitch completed from -6.66 cm (722) to -8.64 cm (90) took 1.8 sec 78mA (286mA peak) 25.9vmin 351 AD/sec 72 ticks
1686.459,HPITCH,N,TRACK: b: 92/0 a: 90/0 d: 2 o: 0
1686.543,HVBD,N,Bleed commanded from 581.84 cc (427) to 571.29 cc (470)...
1687.603,HVBD,N,579.1 cc (ad: 438 [448, 437]) ..MOTOR_DONE: ticks: 6 max 24v: 1224.9mA avg 24v: 209.4mA minV 24v: 26.0v
1689.095,SMOTOR,N,GC TICKS/TIME: 72/74284
1689.149,HVBD,N,done.
1689.191,HVBD,N,Bleed completed from 581.84 cc (427) to 571.29 cc (470 [479, 462]) took 1.6 sec 0mA (1081mA peak) 26.4vmin 27 AD/sec 63 ticks
1689.382,HVBD,N,TRACK: b: 479/462 a: 478/462 d: -8 o: -8
1689.455,SUSR,N,query timeout lengthened, you have one hour to respond
Has the pilot given the OK to launch (no cancels launch, yes proceeds)? [N]
Step 10

Figure 6-7. Final OK to launch

11. **Both Pilot and Field Team**:
    - Immediately after the launch command is given to Seaglider, a communication session with the basestation starts.
    - Both the field team and the pilot should watch to make sure that the session runs completely and properly. This is the last chance to abort the launch sequence easily before putting Seaglider in the water.
12. **Field Team:** If the communication session is acceptable, the field team should disconnect the communications cable at base of antenna and replace it with the water proof dummy plug.
13. **Field team:** Seaglider is now ready for deployment in the ocean. If not already on a ship at sea, load Seaglider and all ancillary equipment needed for the deployment on a boat. An example equipment checklist is in Appendix J, “Sample Field Kit Checklist” on page 343.
14. **Field Team:** Transit to the predetermined launch site. Keep the pilot informed of your progress and estimated time of arrival at the launch site.
15. **Field Team:** As the deployment site nears:
    a. Remove the protective covers from the science sensors.
    b. Place a light tag line around Seaglider, just forward of the rudder so that the line rests in the grooves on the front edge.
    c. Place a safety line on the cradle and tie it off to the boat.

       This prevents its loss should someone let go of it during the deployment.
    d. Set up the acoustic deck unit, including putting a safety line on the transducer and tying it off to the boat and setting the correct transmit frequency for that Seaglider.

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The specific transmit and receive frequencies are listed in the Cal sheet of the Seaglider notebook.

16. **Field Team**: The field team notifies the pilot when they arrive at the final deployment site.
17. **Field Team**: Make sure that the tag line on Seaglider is tied off on the boat. With the boat captain's permission, deploy Seaglider and allow the fairing to fill with water.
18. **Field Team**: Notify the pilot that Seaglider has been deployed and report how Seaglider is sitting in the water.
    - How much of the rudder is showing?
    - How much of the antenna mast is visible.

    If Seaglider is riding well in the water, continue with the testing.

    If Seaglider is riding very low in the water, and more than one-half of the antenna mast is under water there is an issue with the ballasting. Have the pilot verify that the external bladder is fully inflated. If it is not, this could be the issue. However, the question of why the external bladder is not fully inflated must be answered before proceeding. If the bladder is fully inflated (or nearly so), the ballasting weight needs to be verified and, if necessary, some lead attached to the outside of the pressure housing needs to be removed. The pilot determines if any lead has to be removed and from where.
19. **Field Team**:
    - With the captain's permission put the transducer of the acoustic recovery system over the side of the boat and down to a depth of 8-10 feet below the level of the boat's propeller.
    - Transmit a ping.

    The Seaglider system's transponder should respond. The range to Seaglider shows up on the screen of the acoustic deck unit.

    If Seaglider does not respond to the ping try several more times, slightly altering the depth of the transducer and the distance between Seaglider and the transducer.

    If the transponder still does not reply to the interrogation pings contact the pilot. The parameter **$XPDR_VALID** may have to be adjusted by the pilot with the new value sent to Seaglider via the cmdfile.

    If the transponder still does not respond to the transducer's interrogation there may be a problem with the acoustic locator system and Seaglider should be recovered.
20. **Pilot and Field Team**: If Seaglider is riding well in the water and the acoustic ranging system test went well, the pilot instructs the filed team to remove the tag line from Seaglider and standby while Seaglider makes its first dive(s).
21. **Pilot:** The pilot changes the directive in the **cmdfile** from **$QUIT** to **$RESUME** and the file is downloaded to Seaglider the next time it calls the basestation (**$T_RSLEEP** from the last time it called in). After Seaglider receives the new command file it starts the first (shallow) dive.
22. **Field Team:** Notify the pilot when Seaglider leaves the surface.
23. **Pilot:** Change the directive in the cmdfile from **$RESUME** to **$QUIT** so that when Seaglider completes its first dive it remains on the surface.

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Setting up and installing the Argos SPOT5 tag

Equipment Required

- 9/64” hex key
- Kit, Argos WIldlife computers (for standard [long] antenna)
- Brackets
- Screws, socket-head
- Lubricant,TEF-GEL®, anti-corrosion, anti-seize

Equipment Required (Continued)

- In-Line Finmount Transmitter, 258A Configuration
- Kit, Argos - short antenna
- Assembly, Argos, bracket - short antenna
- Argos in-line finmount transmitter, 258A configuration

The Argos SPOT5 transmitter attaches to the antenna, with two saddle brackets and attaching screws. Prior to installation, the SPOT5 operating settings and user parameters must be set.

The Argos kit, provided by iRobot, contains only the attaching hardware required to mount the Argos tag to the Seaglider antenna. Separate kits are available for the standard antenna and the short antenna. Customers may purchase their SPOT5 transmitter separately, and set up their own account, or procure directly from iRobot.

User parameters are programmed into the SPOT5 via a Windows-based program provided by Wildlife Computers called SPOT5Host. The SPOT5 is connected to a PC via the USB-Blue, available from Wildlife Computers only. SPOT5Host synchronizes communications with the POST5's on-board software. It sends and receives commands to the SPOT5. Parameters are downloaded from SPOT5 to the PC. SPOT5Host allows modification of those parameters. After the parameters are set, they can be uploaded to the SPOT5.

Installing the software to a PC

1. Install SPOT5HostInstaller on your PC, from the distribution disk, following the prompts. This version is specific to this application, and was tested on Windows 2000 and Windows XP. Earlier versions of Windows may or may not work depending on the configuration of your PC. Other operating systems (e.g., UNIX) or Windows emulators are not supported.
2. Install the USB-Blue Driver from www.wildlifecomputers.com/downloads.aspx.

   NOTE: Prior to connecting for the first time, the driver must be installed.

3. Start SPOT5Host. A Welcome screen appears.
4. Select **USB Port**.

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Initiating communications with the SPOT5 tag

1. Click **Connect to Tag**.
2. Follow the instructions displayed on the Connection Screen. In this case "Blue box" indicates "USB-Blue."



Figure 6-8. Spot5Host Connection instructions

An LED on the SPOT5 glows when the cables between the PC, USB-Blue, and SPOT5 are connected correctly and the magnet is passed over the reset location of the SPOT5. The LED must be glowing before clicking the OK button. SPOT5Host may display additional prompts if there are difficulties in establishing communications.

CAUTION:
Do not leave the SPOT5 tag hooked up to the communications hardware any longer than necessary to set up or download the tag. Leaving the tag hooked up to the communications hardware for extended periods of time will eventually drain the battery.

Setting SPOT5 parameters

NOTE: If the SPOT5 initial setup has been completed once and saved, follow these steps to upload a previously saved setup.

1. Click **Recall Previous Setup**.
2. Verify parameters are entered correctly as noted in the SPOT5 initial setup.
3. Click **Generate Report** to save a record of the current settings.

SPOT5 initial setup

If using SPOT5Host for the first time, follow the steps listed in this section to set up the basic parameters and the testing of the sensors and transmitter.. This setup may be saved after all parameters are entered. This allows the parameters to be recalled for any future SPOT5 Setups.

Setting general information

1. Set **Maximum number of transmissions per day** to **5760**.
   DO NOT select **Add any unused transmissions to the next day's allowance**.
2. Set **Wet/Dry threshold** to **50** (default).
3. Click the **Set Tag's Time** button.
   A new screen opens.

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4. Use the Automatic Setting from PC's Clock.
   a. First ensure the clock on your PC is accurate.
   b. Set the number of hours to add to the PC's clock to match GMT.
5. Click the **Update** button.
6. Click the **Generate Test Transmission** button.
   Battery voltage during the transmission will be displayed. This should be 2.9V or greater.
7. Click the **Test Sensors** button, and confirm the following values:
   - Volts: greater than 3.0V
   - Temp: current temperature
   - Cond: At least 200 in air (conductivity from wet/dry sensor)

Setting transmission hours

Use the transmission hours tab to set the hours the SPOT5 should transmit. This is dependent on mission and satellite predictions.

- Click the **All On** button.

Setting transmission days

Use the transmission days tab to set the days the SPOT5 should transmit. This is dependent on mission and satellite predictions.

1. Select the **Apply to entire year** option.
2. Click the **All On** button.

Setting transmission intervals

1. The Fast and slow repetition rates are set by the manufacturer.
2. Set the delay to only transmit after ***30*** **more successive dry readings**.
3. Leave the following parameters on default values:
   - Change from Fast to Slow repetition rate after being dry for **99** successive transmissions
   - Pause transmission after being dry for **never** hours
   - Restart transmission after being continuously wet for **8** seconds

Setting time-at-temperature and haulout statistics

The time-at-temperature and haulout statistics features are not currently used by the Seaglider vehicle. Do not change the default settings.

- Verify **Enable haulout statistics** is unchecked (it takes approximately one-third more battery capacity to transmit Temperature Histograms and/or Haulout Statistics).

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Preparing tag for shipment

1. If travel to deployment location takes longer than several hours, turn off the tag off to conserve battery power. This can only be done when the tag is connected to the computer.
2. Click **Update Tag** to upload the parameters entered from the PC to the SPOT5.
3. **Save This Setup** in order to **Recall Previous Setup** upon connecting all subsequent SPOT5s.
4. Click **Generate Report** to save a record of the current settings.

Installing SPOT5 tag on antenna

1. Apply TEF-GEL to the threads of the 4 socket-head screws.
2. Using a 9/64" hex key, loosely install the SPOT5 tag on the antenna, with the two brackets (Figure 6-9).

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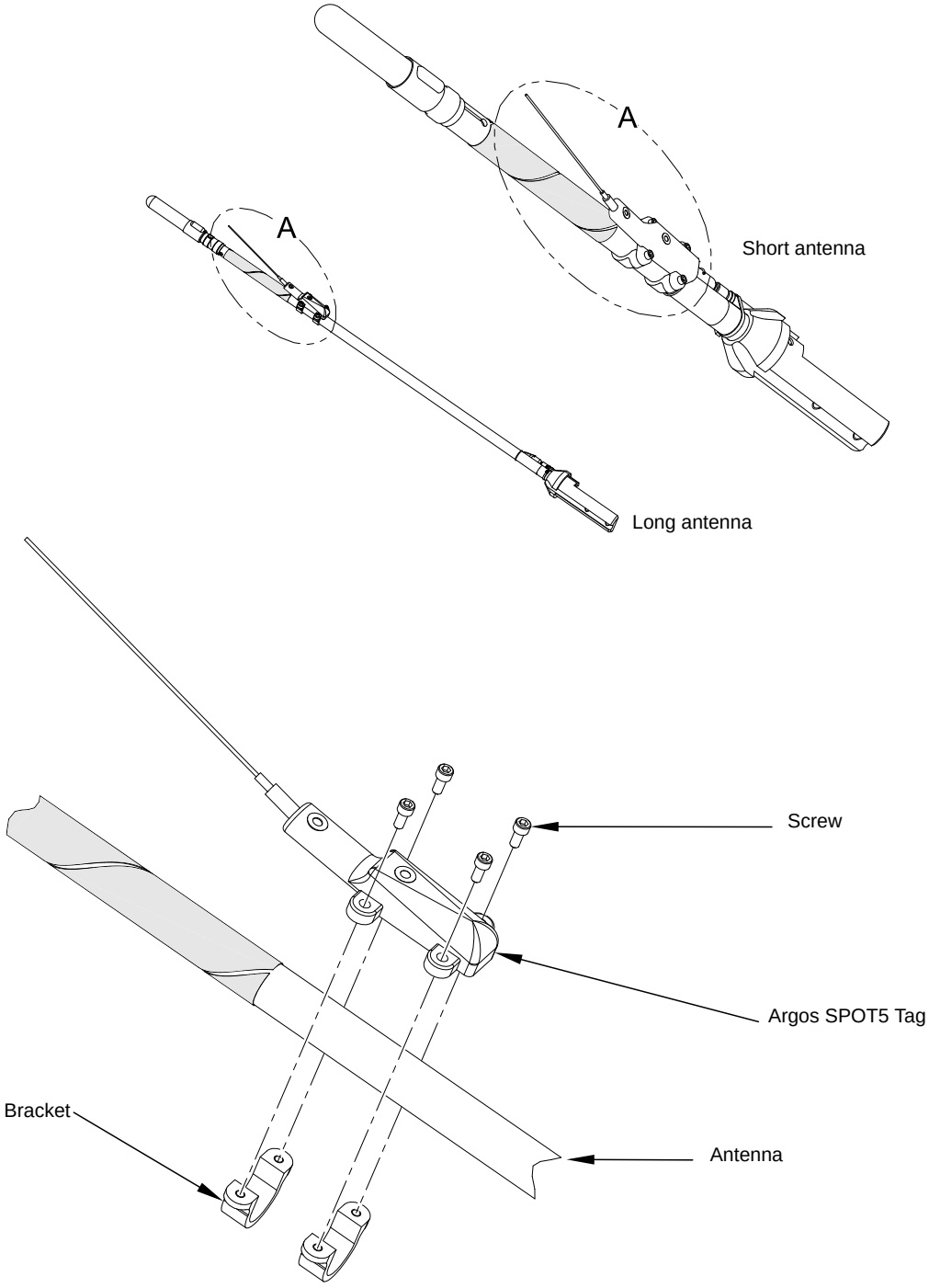


Figure 6-9. Argos SPOT5 installation, detail A

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3. Slide the tag into position, so that the edge of the aft bracket is 1 inch (25.4 mm) from the forward edge of the reflective tape (Figure 6-10).

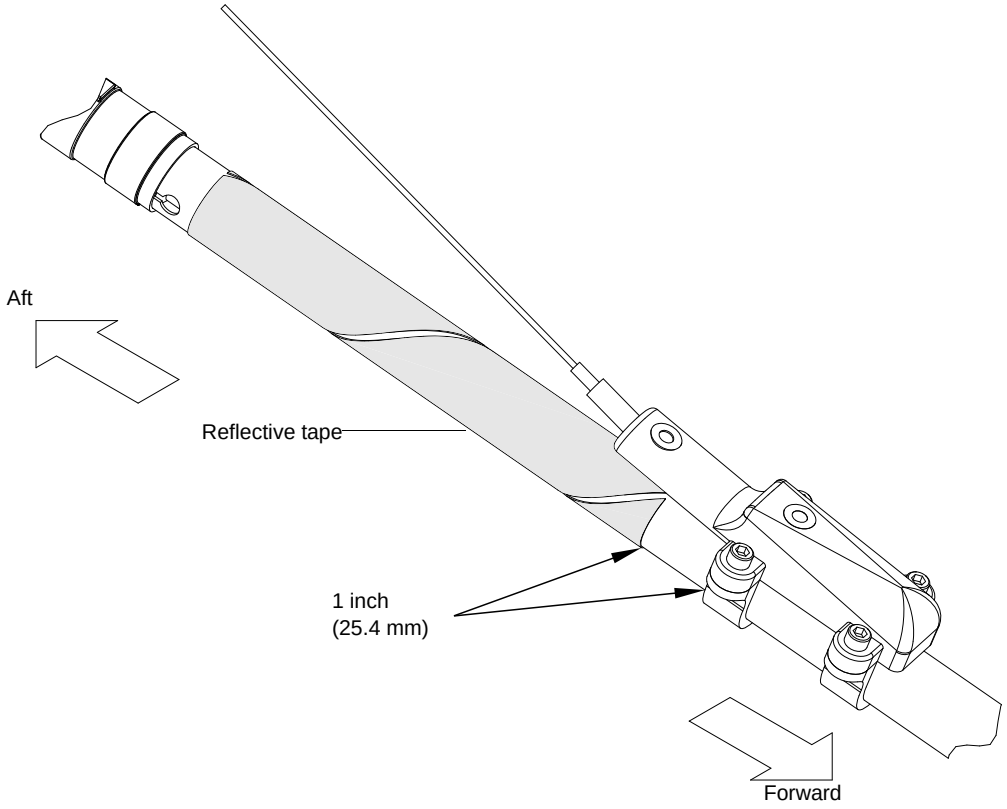


Figure 6-10. Positioning SPOT5 transmitter on antenna

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CHAPTER 7

Prelaunch Procedures

The basic functions of the Seaglider vehicle are tested by completing an interactive self test and simulated dives.

If the Seaglider system was disassembled since completing Chapter 3, “Setting Up the System” on page 7, reassemble all but the rudder and antenna assembly following the directions in “Assembling the Seaglider” on page 14.

If the Seaglider system is fully assembled, but moving it outside is easier without the antenna mast mounted to the aft end of Seaglider, detach it following the steps in “Detaching the antenna mast from aft fairing” on page 117.

NOTE: Do not disconnect the antenna cable for this procedure.

Interactive self test

Perform a self test after every time Seaglider is shipped or reassembled and before it is launched.

1. Locate the calibration and configuration sheets in the notebook or on the CD that was shipped with Seaglider.
2. Move Seaglider outside.

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3. Connect the communications cable (Table 7-1).

Table 7-1. Method of connecting communications cable

Power source for self test	Connection
External power supply	Connect the powered communications cable to Seaglider (Figure 7-3).
Internal battery packs	Connect the 6-pin IE55 end of the non-powered communications cable to the communications port located at the base of the Seaglider antenna mast (Figure 7-1).

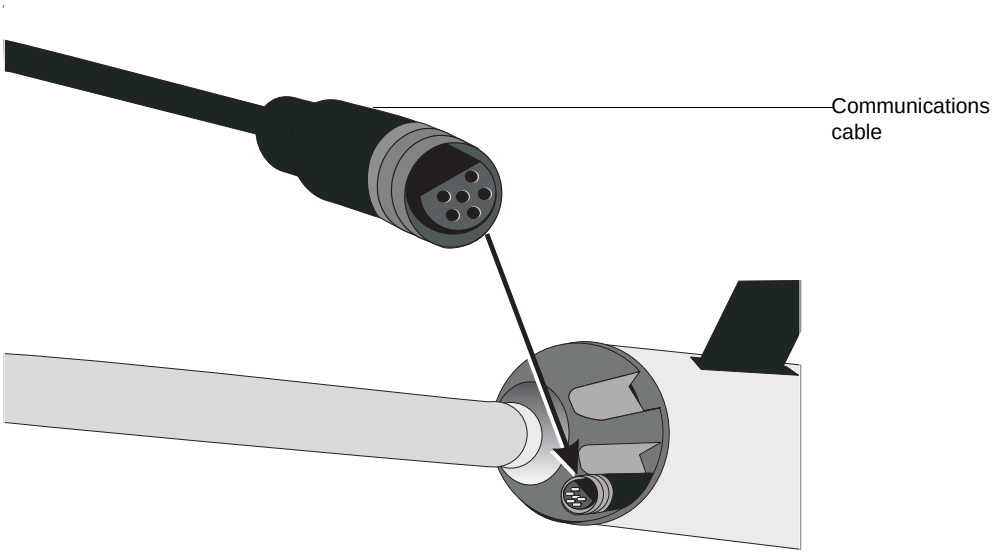


Figure 7-1. Communications cable attached to Seaglider

CAUTION:
Be sure to line up the connector in the proper orientation. Slide the connector in slighty to ensure that the pins are aligned and the connector is properly seated before tightening the knurled metal ring.

4. Position Seaglider, in its cradle, nose down, tail up and make sure the antenna is within 40° of vertical and has an unobstructed view of the sky (Figure 7-2).

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Make sure that Seaglider is secure in this position. Tying it to the secured fixture it is leaning against is recommended.

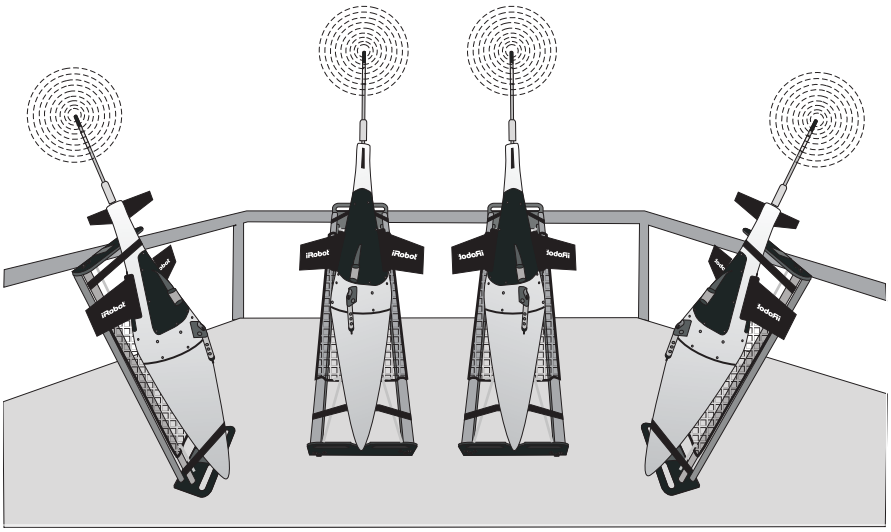


Figure 7-2. Seaglider positioned for self test

5. If Seaglider is being powered externally, set up the dual voltage power supply, checking both voltage output and current limit. Set one supply to 24V with a 2 amp current limit and the other supply to 10V with a 2 amp current limit. Connect the banana plugs on the powered communications cable to the power supplies.
6. Connect the communication cable to the DB9 connector on the laptop and power up the laptop if it has not already been done.

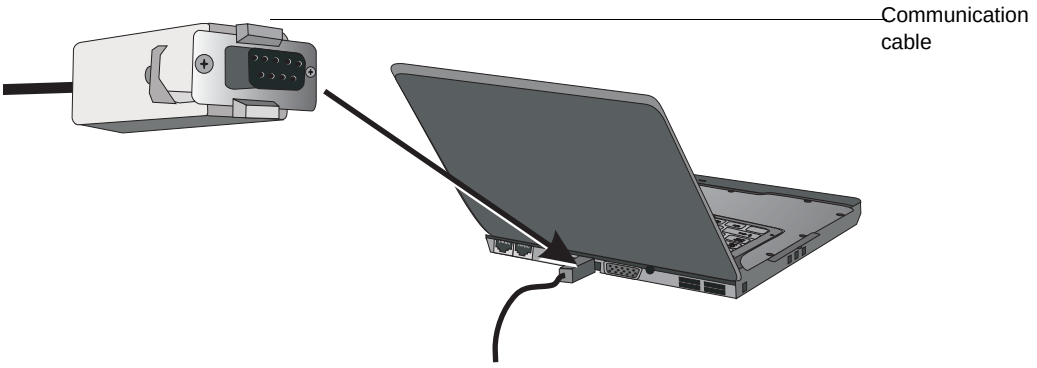


Figure 7-3. Connecting the communication cable to the laptop

7. Start the terminal emulation program and start a screen capture file or a session log-file on the laptop.
8. Turn on the power supplies, if Seaglider is being powered externally.
9. Wand on Seaglider. See page 21 for instructions on wanding on Seaglider.

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10. When the output starts scrolling on the computer screen, press Enter within one minute (Figure 7-4).

    NOTE: While performing the following steps, watch the process on the laptop and note if there are any errors or warnings. The screen capture file can also be checked at the end of the test for warnings and errors.

    After any query, press Enter for the default answer/value shown in brackets,[ ], after the question.

```
Version 66.07/18:775 starting up Mar 29 2011 10:36:24
Seaglider operating software developed and maintained by
Applied Physics Laboratory, University of Washington
Copyright 2003-2010, University of Washington
Built with SCENARIO, without ICE, without RAFOS, without KERMIT,
     without ARS, without MMODEM, without PAAM, without AQUADOPP, without SAILCT,
    without DEEPGLIDER, without HEAP RECYCLE, with REV_C, without LUA
with serial and logger device sensor integration facilities
developed by Integrative Observational Platforms Group, APL-UW
_mtop = 0x2fefff, _mbot = 0x28cdb8, _mcur = 0x28e000
glmalloc_init: glmalloc_data_init = 0x0
glmalloc_init: avail_bytes = 434175, requested_bytes = 358400
glmalloc_init: Allocated 358400 bytes.
1301395235.048,SSENSOR,N,reading cnf GPCTDDO.cnf
1301395235.409,SSENSOR,N,assigned WL_BBFL2VMT to sensor slot 1 (p = 83)
1301395235.594,SSENSOR,N,assigned GPCTD to logger sensor slot 1 (p = 85)
1301395235.750,SSENSOR,N,assigned empty to logger sensor slot 3 (p = 0)
1301395237.358,SPOWER,N,Iridium_during_init saved current=0.10300
1301395237.539,SPOWER,N,Iridium_during_connect saved current=0.16000
1301395237.725,SPOWER,N,Iridium_during_xfer saved current=0.22300
1301395237.907,SPOWER,N,GPS saved current=0.02696
1301395238.067,SPOWER,N,TT8 saved current=0.01496
1301395238.227,SPOWER,N,TT8_Active saved current=0.01421
1301395238.397,SPOWER,N,TT8_Sampling saved current=0.03743
1301395238.570,SPOWER,N,TT8_CF8 saved current=0.04717
1301395238.737,SPOWER,N,TT8_Kalman saved current=0.05915
1301395238.908,SPOWER,N,Analog_circuits saved current=0.01200
1301395239.085,SPOWER,N,Compass saved current=0.01573
1301395239.242,HCOMPASS,N,Active compass is SP3003
1301395239.413,SSYS,N,Changing capture file
1301395239.518,SSENSOR,N,sensor SBE_CT not found in installed sensors!
1301395239.655,SSENSOR,N,sensor SailCTx not found in installed sensors!
1301395239.789,SSENSOR,N,no CT sensor configured
1301395244.621,SUSR,N,Glider 524, mission 6, dive 5, booted Tue Mar 29 10:40:44 2011, boot #374
1301395245.510,HXPDR,N,max range = 60.000000 m, timeout = 80 ms
1301395245.777,SSURF,N,Hit CR within 1 minute to start, otherwise will go to recovery ...
Set current date and time
<CR> for default [03/29/2011 10:40:48]
Are you running on external (bench) power? [N] y
1301395252.545,SPOWER,N,Not tracking power consumption!

------ Main Menu ------
     1 [param    ]  Parameters and configuration
     2 [hw       ]  Hardware tests and monitoring
     3 [modes    ]  Test operation modes and files
     4 [pdos     ]  PicoDOS commands (and exit)
     5 [launch   ]  Pre-launch
Enter selection (1-5,CR): 2
```

Figure 7-4. Seaglider start-up on the laptop

11. Set the current date and time (GMT) in response to the query (Figure 7-4).

    A time within 12 hours is acceptable because Seaglider gets an accurate time from its first GPS fix and resets the internal clock. Note that the format must be in mm/dd/yyyy hh:mm:ss, with no missing values or extra spaces.

12. When prompted “Are you running on external (bench) power?,” (Figure 7-4), do one of the following:

    - Type Y (for Yes) to indicate that you are using a powered communications cable, and press Enter.
    - Press Enter to accept the default (N for No) if you do not have an external power source (using non-powered communications cable).

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Once the ‘Are you running on external (bench) power question is answered, the main Seaglider menu appears (Figure 7-4).

If your Seaglider is equipped with a GPCTD, continue with step 13; otherwise skip to step 14.

13. Turn off the GPCTD.

    a. On units equipped with GPCTD it is necessary to turn off the GPCTD pump during self tests and simulated dives. The pump may be damaged by running dry so this is necessary to comply with manufacturer's recommended operating procedures.

    NOTE: Do not skip any steps. Failure to perform all steps as indicated can result in improper operation and/or tracking of power consumption of the GPCTD.

```
------ Main Menu ------
     1 [param   ]  Parameters and configuration
     2 [hw      ]  Hardware tests and monitoring
     3 [modes   ]  Test operation modes and files
     4 [pdos    ]  PicoDOS commands (and exit)
     5 [launch  ]  Pre-launch
Enter selection (1-5,CR): 2

------ Hardware Menu ------
*Motors and VBD
     1 [pitch   ]  Pitch control
     2 [roll    ]  Roll control
     3 [vbd     ]  VBD control
*Fixed Devices
     4 [super   ]  Supervisor
     5 [pressure]  Pressure sensor
     6 [compass ]  Compass (tcm2)
     7 [gps     ]  GPS
     8 [modem   ]  Modem (xmodem mode)
     9 [intpress]  Internal pressure
    10 [altim   ]  Altimeter
    11 [sensors ]  Sensors
    12 [loggers ]  Loggers
*Other
    13 [batt    ]  Batteries and fuel gauges
    14 [lowlevel]  Low-level hardware (IO,A-D,CF)
    15 [misc    ]  Miscellaneous (travel, timeouts, date/time)
    16 [develop ]  Developer tests
    CR)  Return to previous
Enter selection (1-16,CR): 12

------ Loggers menu ------
     1 [pc      ]  GPCTD
     2 [        ]  empty
    CR)  Return to previous
Enter selection (1-2,CR): 1
```

Figure 7-5. Loggers menu

    b. Press **2** and press Enter to enter the Hardware menu.

    c. Press **12** and press Enter to enter the Loggers menu.

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d. Press **1** and press Enter to enter the GPCTD menu.

```
------ Logger device test menu ------
     1 [on       ]  Turn on
     2 [off      ]  Turn off
     3 [selftest ]  Selftest
     4 [sample   ]  Report a sample
     5 [syncclk  ]  Synchronize device clock to TT8
     6 [clock    ]  Read device clock
     7 [file     ]  Get file from device
     8 [action   ]  Execute logger action
     9 [config   ]  Show configuration
    10 [edit     ]  Edit configuration
    11 [direct   ]  Direct comms
    CR)  Return to previous
Enter selection (1-11,CR): 11
35.883,HGPCTD,N,RX = 10, TX = 11
36.579,SUSR,N,Starting breakable loop - Ctrl-Q to end

S>GetCD
<ConfigurationData DeviceType = 'SBE Glider Payload CTD' SerialNumber = '70100016'>
   <SampleDataFormat>HEX engineering</SampleDataFormat>
   <RS232ForceOn>yes</RS232ForceOn>
   <TxRealTime>no</TxRealTime>
   <SampleInterval>1</SampleInterval>
   <SampleMode>Continuous</SampleMode>
   <AutoRun>no</AutoRun>
   <SBE43>yes</SBE43>
   <MinCondFreq>3212.0</MinCondFreq>
   <CustomPumpMode>no</CustomPumpMode>
</ConfigurationData>
S>minCondfreq=10000
S>GetCD
<ConfigurationData DeviceType = 'SBE Glider Payload CTD' SerialNumber = '70100016'>
   <SampleDataFormat>HEX engineering</SampleDataFormat>
   <RS232ForceOn>yes</RS232ForceOn>
   <TxRealTime>no</TxRealTime>
   <SampleInterval>1</SampleInterval>
   <SampleMode>Continuous</SampleMode>
   <AutoRun>no</AutoRun>
   <SBE43>yes</SBE43>
   <MinCondFreq>10000</MinCondFreq>
   <CustomPumpMode>no</CustomPumpMode>
</ConfigurationData>
S>start
<!--start logging-->
S>    0.08, 15.4768, 0.00004
    0.09, 15.4771, 0.00004
    0.08, 15.4770, 0.00003
    0.07, 15.4778, 0.00003
    0.08, 15.4782, 0.00003
    0.08, 15.4788, 0.00003
    0.09, 15.4789, 0.00003
    0.09, 15.4798, 0.00003
    0.07, 15.4797, 0.00003
    0.08, 15.4799, 0.00003
    0.08, 15.4808, 0.00003
    0.08, 15.4811, 0.00003

<logging stopped/>
S>
------ Logger device test menu ------
     1 [on       ]  Turn on
     2 [off      ]  Turn off
     3 [selftest ]  Selftest
     4 [sample   ]  Report a sample
     5 [syncclk  ]  Synchronize device clock to TT8
     6 [clock    ]  Read device clock
     7 [file     ]  Get file from device
     8 [action   ]  Execute logger action
     9 [config   ]  Show configuration
    10 [edit     ]  Edit configuration
    11 [direct   ]  Direct comms
    CR)  Return to previous
Enter selection (1-11,CR): 2
```

Figure 7-6. Turning off the GPCTD

e. Press **11** and press Enter to go into direct serial communications with the GPCTD.

f. Press Enter until a `S>` prompt appears.

g. Type `GetCD` and press Enter.

h. Find the value labeled MinCondFreq and record that value so you can use it later to turn the pump back on.

i. Type `MinCondFreq=10000` and press Enter.

j. Type `GetCD` and press Enter.

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- Find the value labeled MinCondFreq and confirm it has been set to 10000.

k. Type `Start` and press Enter.

l. Wait for 30 secs. (You may be able to hear the pump is stopped, though the sound is hard to hear externally.)

m. Type `Stop` and press Enter to stop system and get prompt back. You will not see the word "Stop" displayed – but a message will appear that the "logging stopped."

n. Press Ctrl-Q to exit direct communications with the GPCTD.

o. Once back at the GPCTD menu, type **2** and press enter to turn off the GPCTD.

p. Press Enter until you return to the main menu.

q. Wand the glider off.

r. Wand the glider back on to continue testing/operations.

14. Test the Seaglider altimeter/transponder.

```
------ Main Menu ------
     1 [param   ]  Parameters and configuration
     2 [hw      ]  Hardware tests and monitoring
     3 [modes   ]  Test operation modes and files
     4 [pdos    ]  PicoDOS commands (and exit)
     5 [launch  ]  Pre-launch
Enter selection (1-5,CR): 2

------ Hardware Menu ------
*Motors and VBD
     1 [pitch   ]  Pitch control
     2 [roll    ]  Roll control
     3 [vbd     ]  VBD control
*Fixed Devices
     4 [super   ]  Supervisor
     5 [pressure]  Pressure sensor
     6 [compass ]  Compass (tcm2)
     7 [gps     ]  GPS
     8 [modem   ]  Modem (xmodem mode)
     9 [intpress]  Internal pressure
    10 [altim   ]  Altimeter
    11 [sensors ]  Sensors
    12 [loggers ]  Loggers
*Other
    13 [batt    ]  Batteries and fuel gauges
    14 [lowlevel]  Low-level hardware (IO,A-D,CF)
    15 [misc    ]  Miscellaneous (travel, timeouts, date/time)
    16 [develop ]  Developer tests
    CR)  Return to previous
Enter selection (1-16,CR): 10

------ Altimeter/XPDR Menu ------
     1 [ping    ]  Ping the altimeter
     2 [config  ]  Upload configuration to altimeter
     3 [count   ]  Query the transponder ping count
     4 [xpdrcfg ]  Update XPDR configuration from parameters
     5 [direct  ]  Direct comms with altimeter
     6 [param   ]  Edit altimetry parameters
    CR)  Return to previous
Enter selection (1-6,CR): 3
956.913,HXPDR,N,ping count 0

------ Altimeter/XPDR Menu ------
     1 [ping    ]  Ping the altimeter
     2 [config  ]  Upload configuration to altimeter
     3 [count   ]  Query the transponder ping count
     4 [xpdrcfg ]  Update XPDR configuration from parameters
     5 [direct  ]  Direct comms with altimeter
     6 [param   ]  Edit altimetry parameters
    CR)  Return to previous
Enter selection (1-6,CR): 3
1033.230,HXPDR,N,ping count 3
```

Figure 7-7. Altimeter check

a. Set up the acoustic deck box.

b. Set the correct transmit frequency on the deck box. This frequency is in the notebook that was shipped with Seaglider.

c. Put the transducer next to the nose of Seaglider, touching the fairing.

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d. From the Main Menu, type **2** (Hardware tests and monitoring) and press Enter (Figure 7-7).

e. Select **10**: **Altimeter** and press Enter (Figure 7-7)

f. Select **3**: **Query the transponder ping count**. Ping count should be 0. If not, select 3 again until ping count is 0.

g. Send a ping from the deck box to Seaglider. The system displays a response on the screen of the deck box and on the laptop. The display on the deck box is automatic. To see the ping count on the laptop (Figure 7-7), select 3: Query the transponder ping count and the count should go up to the number of times the deck box was pinged.
Seaglider returns to the Altimeter/XPDR menu.

h. If there is no response to the ping, do the following:

- Send another ping.
- If there is still no response, move the transducer around the nose a bit.
- If there still is no response after several more ping attempts, there may be an issue with the acoustic locator system or there could just be an air gap between the two transducers. You should investigate and resolve the problem, however, the acoustic locator system is not critical to the rest of the self test so you may choose to continue the testing and investigate the acoustic system problem separately.

15. Press Enter until the Main menu appears (Figure 7-7).

16. Type **5**: **Pre-launch** options, and then press Enter (Figure 7-8). The Launch Menu appears.

```
------ Main Menu ------
     1 [param   ]  Parameters and configuration
     2 [hw      ]  Hardware tests and monitoring
     3 [modes   ]  Test operation modes and files
     4 [pdos    ]  PicoDOS commands (and exit)
     5 [launch  ]  Pre-launch
Enter selection (1-5,CR): 5

------ Launch Menu ------
     1 [scene   ]  Set scenario mode
     2 [selftest]  Perform interactive self test
     3 [autotest]  Perform autonomous self test
     4 [uploadst]  Upload self-test results
     5 [reset   ]  Reset dive/run number
     6 [test    ]  Test Launch!
     7 [sea     ]  Sea Launch!
    CR)  Return to previous
Enter selection (1-7,CR): 2
```

Figure 7-8. Interactive self test

17. Type **2**: **Perform interactive self test**, and then press Enter (Figure 7-8).

18. The prompt “Remove old data/log files (for self test before sea launch)? [N]” appears.

WARNING:
Selecting ‘Yes’ removes all data files still on Seaglider from prior missions and tests. Be sure that those files are saved elsewhere BEFORE selecting ‘Yes’. If it is unknown whether the files have been saved, select N.

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Figure 7-9 shows file removal.

```
Remove old data/log files (for self-test before sea launch)? [N]  y
4.171,SUSR,N,Removing old data and log files
Deleting SG0000KZ.A...
Deleting SG0000LZ.A...
Deleting SG0001KZ.A...
Deleting SG0001DZ.A...
Deleting SG0001LZ.A...
5 files deleted.
4.047,SUSR,N,Tue Mar 29 10:41:06 2011
```

Figure 7-9. Removing old data/log files

19. At the prompt "Can the antenna be used for GPS and communications? [Y]," press Enter to accept the default answer, Yes (Figure 7-10).

```
Can the antenna be used for GPS and communications? [Y]
Verify GPS and communications parameters? [Y]
$ID
New value? [524.00]
$MISSION
New value? [6.00]
20.765,SUSR,N,Current password is 524680
New password (15 char max length, CR to leave unchanged):
23.299,SUSR,N,Current telnum is 19195726671
New telnum (15 char max length, CR to leave unchanged):
25.834,SUSR,N,Current altnum is 19195726670
New altnum (15 char max length, CR to leave unchanged):
27.705,SUSR,N,$CALL_TRIES: 5 OK
27.808,SUSR,N,$N_NOCOMM: 1 OK
$T_GPS
New value? [15.00]
29.898,SUSR,N,Place glider in position for communications..
Hit CR to continue
```

Figure 7-10. Seaglider ID verification and communications set up

NOTE: This answer is critical. The answer Yes means that the Seaglider antenna is in position for communications and ready to be launched.

20. At the prompt "Verify the GPS and communications parameters? [Y]," press Enter to accept the default answer, Yes (Figure 7-10).
21. Verify Seaglider ID number by comparing the ID on the aft fairing, just forward of where the antenna mast is bolted into the fairing, with the number on the screen (Figure 7-10).
22. The ID is a three digit number.
23. If the ID numbers agree, press Enter to accept the default (Yes) (Figure 7-10).
24. If the IDs do not agree, investigate and correct the cause of the discrepancy before continuing with the testing. The calibration coefficients are assigned to a Seaglider based on the ID, and the serial number is based on the ID.
25. Verify the Mission Number, and then press Enter to accept the default, 0, for the first self test (Figure 7-10).

    Subsequent self tests are numbered sequentially by Seaglider. You can override the Seaglider-generated number with your own number.

    You define subsequent mission numbers either here of through the cmdfile from the basestation.

    The current password appears.
26. Verify the current password (Figure 7-10).

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At the prompt “New password (15 char max length, CR to leave unchanged),” type a new password and press Enter, or press Enter to leave the password unchanged (Figure 7-10).

The password installed at the factory is six digits:

- The first three digits are the ID number of the Seaglider system.
- The last three digits are 680, if the ID is even, or 791, if the ID is odd.

If you want to use a different password, it cannot be more than 15 characters. The characters can be any alphanumeric string, but no punctuation or special characters are allowed.

If you change Seaglider system’s password that was installed at the factory, you must also make a corresponding change on the basestation for this Seaglider. Changing the password is NOT recommended.

If the password is incorrect, the test failed.

CAUTION:
Investigate and correct the cause of the discrepancy before continuing with the testing. A Seaglider cannot call the basestation unless the password is the same on both the basestation and Seaglider.

27. Set the primary telephone number.

    At the prompt “New telnum (15 char max length, CR to leave unchanged),” verify that the number displayed matches the number of the telephone line going into the first basestation modem (Figure 7-10).

    The telephone number is unique to that phone line. It starts with the international country code, without leading zeros (for example, “1” for the US), then city/area code and number. There are no spaces or other interrupting characters between the country code, city/area code or number.

    Do one of the following:

    - If the telephone numbers match, press Enter to accept without making changes (Figure 7-10).
    - If the telephone numbers do not match, enter the correct number and press Enter (Figure 7-10).

28. Set the alternate telephone number.

    At the prompt “New altnum (15 char max length, CR to leave unchanged,” verify that the value displayed matches the number of the telephone line going into the second basestation modem (Figure 7-10).

    The alternate number is unique to that phone line.

    Do one of the following:

    - If the telephone numbers match, press Enter to accept without making changes (Figure 7-10).
    - If the telephone numbers do not match, enter the correct number and press Enter (Figure 7-10).

29. Put Seaglider in position for communications, if it is not already there. Seaglider should be outdoors, nose down with the antenna pointed to within 40 degrees of vertical.
30. When Seaglider is in position, press Enter (Figure 7-10).

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31. At the prompt “Allow the GPS to acquire the almanac? [N],” should press Enter to accept the default ‘No.’

```
32.064,SUSR,N,---- Checking GPS ----
32.149,HGPS,N,Obtaining GPS fix
53.340,HGPS,N,0 recent almanac sentences returned, consider acquiring new almanac data
53.456,HTT8,N,Updating parameter $T_GPS_CHARGE to -6158.4648
Allow the GPS to acquire the almanac? [N]
115.910,HGPS,N,Acquiring GPS fix ...
117.756,HGPS,N,VVVVVVVVVVVVA
1497732.001,HGPS,N,sync sentence $GPRMC,184313,A,3556.3498,N,07854.1015,W,000.0,000.0,150411,008.7,W*7D
1497732.131,HGPS,N,set 2011/04/15 18:43:14
1497732.572,HGPS,N,confirm $GPRMC,184314,A,3556.3499,N,07854.1015,W,000.0,000.0,150411,008.7,W*7B
1497732.718,HGPS,N,150411, 184312, 3556.349365, -7854.101562 1.700000 16/16 seconds
1497733.333,HTT8,N,Updating parameter $T_GPS_CHARGE to -6159.0952
1497735.786,SUSR,N,---- Checking Iridium phone ----
1497737.068,HPHONE,D,Copyright(c) 2009
1497737.162,HPHONE,D,NAL Research Corporation
1497737.269,HPHONE,D,Iridium Modem Model: A3LA-XG
1497737.334,HPHONE,N,error collecting signal strength from phone
1497738.417,HPHONE,D,lat: 0.000000, lon: 0.000000, time: Thu Jan  1 00:00:00 1970
1497740.554,HPHONE,D,AT+CREG?
1497740.620,HPHONE,D,+CREG:000,004
1497740.669,HPHONE,N,WARNING: Phone reported 4 stat on CREG?
1497740.748,HPHONE,D,
1497740.780,HPHONE,N,CREG failed - phone not registered
Continue self-test? [N] y
```

Figure 7-11. Checking GPS and Iridium

NOTE: Seaglider has 15 minutes (T_GPS) to acquire a GPS position. If it does not, once the test is started, the test fails.

Seaglider then tests the Iridium phone connection to the satellites. Often this fails because the code does not wait long enough to measure signal strength or register on the Iridium system. At this time, you can ignore the failed ‘CREG’ because the self test tries to make another Iridium call at the end of the self test procedure.

32. At the prompt “Continue to Self Test?[N],” type `Y` (for Yes), and then press Enter (Figure 7-11).
33. Seaglider checks for bathymetry maps (Figure 7-12).
34. If the self test returns the message “Warning: No bathymetry file covers the current locations! Continue self test?[N],” do one of the following:
    - If the test is being conducted on land, where there are no bathymetry files available, or if on the water, but it is known that no bathymetry maps are loaded for the present area, type Y (for Yes), and press Enter (Figure 7-12).
    - If bathymetry maps are supposed to have been loaded, type `N` (default), and press Enter to not continue the self test. The test fails (Figure 7-12). Determine the cause for the inability to find the maps. Check the filenames. The format must be bathymap.nnn where nnn is the map’s number.

```
1497750.851,SUSR,N,---- Checking bathymetry data ----
1497750.964,SUSR,N,Normal Heap: 0+73727 bytes
1497751.107,SQLMALLOC,N,glheap_walk: 354980 bytes free, 2 blocks free, 2820 bytes alloc, 23 blocks alloc
1497755.911,SBATHY,N,Loaded bathymap.006 [156 100] 100m (LL) 47.6800,-122.5000 (UR) 47.8704,-122.3663
1497758.465,SBATHY,N,Loaded bathymap.007 [ 56  75] 100m (LL) 47.6500,-122.5000 (UR) 47.7004,-122.3998
1497769.116,SBATHY,N,Loaded bathymap.014 [135 147] 500m (LL) 28.4643,-89.0336 (UR) 29.0268,-88.2813
1497769.464,SBATHY,N,WARNING: No bathymetry file covers the current location (3556.349365,-7854.101562)!
1497770.524,SQLMALLOC,N,glheap_walk: 318024 bytes free, 3 blocks free, 39704 bytes alloc, 25 blocks alloc
Continue self-test? [N] y
```

Figure 7-12. Checking bathymetry data

35. After the bathymetry check, compass and calibration file checks are done.

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Verify that the values for pitch, roll, hard iron and soft iron are non-zero. If the values are zero, the test fails (Figure 7-13).

```
$497776.543,SUSR,N,---- Checking compass and calibration files ----
1497776.746,HCOMPASS,N,Compass I, SP3003
1497776.991,HCOMPASS,N,pitch A,B,C,D: -0.004800 1.012200 -0.008200 -0.002100
1497777.293,HCOMPASS,N,roll A,B,C,D:  -0.006700 -7.096700 8.482200 0.001000
1497777.586,HCOMPASS,N,hard iron P,Q,R: 22.632999 51.560799 36.951199
1497777.834,HCOMPASS,N,soft iron: 1.002400 -0.015200 -0.004200
1497778.069,HCOMPASS,N,           0.001000 1.062200 0.002400
1497778.307,HCOMPASS,N,           0.011000 0.017500 1.060800
1497779.828,HCOMPASS,N,compass filter disabled ok
1497780.659,HCOMPASS,N,1, SP3003, Hdg: 20.00 deg Rol: 134.96 deg Pit: -65.32 deg Tmp: 24.70 C
```

Figure 7-13. Compass calibration

36. Verify that the critical operational parameters are OK (Figure 7-14).

```
$497780.843,SUSR,N,---- Verifying critical operational parameters ----
1497781.002,SUSR,N,$RELAUNCH: 1 OK
1497781.131,SUSR,N,$AD7714ch0Gain: 128 OK
1497781.226,SUSR,N,$SIM_PITCH: 0 OK
```

Figure 7-14. Critical operational parameters

37. The glider will now report a full listing of all the installed hardware and software (Figure 7-15).

```
$497781.315,SUSR,N,---- Reporting hardware configuration ----
1497781.456,SUSR,N,Sensor in slot 1 is WL_BBFL2VMT on port 3, TPU06/TPU07, nominally 'Optics 1'
1497781.625,SUSR,N,Sensor in slot 2 is not installed
1497781.736,SUSR,N,Sensor in slot 3 is not installed
1497781.847,SUSR,N,Sensor in slot 4 is not installed
1497781.958,SUSR,N,Sensor in slot 5 is not installed
1497782.069,SUSR,N,Sensor in slot 6 is not installed
1497782.206,SUSR,N,Logger sensor in logger slot 1 is GPCTD on port 5, TPU10/TPU11 (mux channel 0), nominally 'Optics 2'
1497782.410,SUSR,N,Logger Sensor in logger slot 2 is not installed
1497782.561,SUSR,N,Logger sensor in logger slot 3 is empty on port 0, TPU-1/TPU-1, nominally 'null'
1497782.739,SUSR,N,Logger Sensor in logger slot 4 is not installed
1497782.865,SUSR,N,Motherboard is Rev.B.1
1497782.957,SUSR,N,Phone is Iridium9522
1497783.045,SUSR,N,GPS is Garmin_GPS15H
1497783.134,SUSR,N,Compass is SP3003
1497783.220,SUSR,N,Spare compass is not installed
1497783.322,SUSR,N,XPDR is AAE_955
1497783.466,SUSR,N,External pressure sensor gain (128.000000) consistent with Paine
1497784.468,SUSR,N,---- Reporting software version ----
1497784.611,SUSR,N,Version: 66.07
1497784.697,SUSR,N,Compiled on: Mar 29 2011 10:36:24
1497784.804,SUSR,N,From SVN version 18:775
1497784.896,SUSR,N,Compiler: gcc
1497784.978,SUSR,N,Compiled with SCENARIO support
1497785.083,SUSR,N,Compiled without ICE support
1497785.185,SUSR,N,Compiled without RAFOS support
1497785.291,SUSR,N,Compiled without Kermit support
1497785.397,SUSR,N,Compiled without ARS support
1497785.499,SUSR,N,Compiled without PAAM support
1497785.601,SUSR,N,Compiled without AQUADOPP support
1497785.711,SUSR,N,Compiled without SAILCT support
1497785.820,SUSR,N,Compiled without MicroModem support
1497785.933,SUSR,N,Compiled without DeepGlider support
1497786.046,SUSR,N,Compiled without Heap Recycle support
1497786.164,SUSR,N,Compiled with Rev C Motherboard support
1497786.281,SUSR,N,Compiled without LUA support
1497786.393,SUSR,N,NVRAM: 178 parameters, 716 bytes, 186 bytes in utility storage
1497786.538,SUSR,N,Buffers: static
1497786.619,SUSR,N,Active (2Mhz)
1497786.700,SUSR,N,PicoDOS version: C82#2651-1.63b
1497786.804,SUSR,N,Launched as: MAIN
1497786.893,SUSR,N,Normal Heap: 0473727 bytes
1497787.036,SQLMALLOC,N,glheap_walk: 317984 bytes free, 3 blocks free, 39720 bytes alloc, 26 blocks alloc
1497787.212,SUSR,N,Sensors: WL_BBFL2VMT
```

Figure 7-15. Reporting hardware configuration and software versions

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38. The glider will next report a full listing of all the directory contents (Figure 7-16).

```
18158.855,SUSR,N,---- Reporting directory contents ----
BATHYMAP.001          33792
BATHYMAP.002          38272
BATHYMAP.003          26752
BATHYMAP.004          48896
BATTERY                 494
BG072110                482
CMDFILE                 709
RUN099.CFG              322
SCIENCE                 129
SG001PRM.TXT           2785
BG012611                484
TARGETS                 361
MAIN.RUN             490112
GPCTD.CNF               768
TCM2MAT.001             192
TCM2MAT.526             256
TCM52600.AVE           4830
TCM52600.RAW          85037
THISDIVE.DAT           3775
THISDIVE.KAP           4118
THISDIVE.LOG           5791
THISDIVE.WRK            129
6606.RUN             469720
CURRENTS                256
LOGGERS.CMD             109
SG0000KZ.A             2710
BG010311                497
OLDMAIN.RUN          489988
SG0000LZ.A             1374
SG0001KZ.X02           2137
SG0001KZ.A            10329
SG0001DZ.A             1209
SG0001LZ.A             2619
SG526PRM.TXT           2899
RECEIVE.000             256
RECEIVE.001               0
RECEIVE.002             768
QSP2150.CNF             128
RECEIVE.003             256
RECEIVE.004             384
WLBB2F.CNF              256
WLBB2FL.CNF             256
WLBBFL2.CNF             256
660701.RUN           490240
BG020711                488
2225621 bytes used; 45 files
```

Figure 7-16. Reporting directory contents

39. Verify the pressure sensor (Figure 7-17).

```
1497795.211,SUSR,N,---- Checking pressure sensor ----
Are you at sealevel? [Y]
Number of samples to collect and average: [11]
Show all samples? [N]
1497802.425,HPRES,N,                 A/D          Volts     Meters
1497802.671,HPRES,N, Mean:           415373.6     0.482591  0.01
1497802.937,HPRES,N, RMS:            415373.8     0.482592  0.01
1497803.148,HPRES,N, Min:            414718       0.481830  -0.04
1497803.361,HPRES,N, Max:            416149       0.483492  0.07
1497803.538,HPRES,N, Peak-to-peak:   1431         1.662571  uV

1497803.705,HPRES,N, Volts per bit: 1.161825e-09

1497803.811,HPRES,N,Y-intercept is set correctly
```

Figure 7-17. Checking pressure sensor

a. At the prompt “Are you at sea level? [Y],” type **Y** (for Yes, default) if you are at sea level or N (for No), and then press Enter (Figure 7-17).
b. At the prompt “Number of samples to collect and average: [11],” press Enter to accept the default of 11 (Figure 7-17).
c. At the prompt “Show all samples? [N],” press Enter to accept the default N (Figure 7-17).

   The results from the sea level calibration display.

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d. At the prompt “If truly at sea level, this data suggests it should be xx.x(psig). Accept new value?[N], do one of the following:

- If Seaglider is at sea level and you want to accept the new value, type **Y** (for Yes), and then press Enter.
- If Seaglider is not at sea level, press Enter to accept the prior value.

If your Seaglider is equipped with a GPCTD then continue with step 40, otherwise skip to step 41.

40. The GPCTD configuration is now verified. Values for “clock sync string is” and “fmt into strftime =” are read from the configuration file loaded for the GPCTD sensor. The raw data for the sensor is returned in the form of the hex string at the end of the verification (Figure 7-18).



Figure 7-18. Checking GPCTD

41. Check the pitch motor and values (Figure 7-19).


S>---- Checking pitch, roll, and VBD. ----
Hit ctl-Q to interrupt current test and continue...
1497817.346,SUSR,N,---- Checking pitch motor ----
verify pitch SW limits and timeouts? [Y]
$PITCH_MIN
New value? [80.00]
$PITCH_MAX
New value? [3853.00]
$PITCH_TIMEOUT
New value? [16.00]
1497845.650,SUSR,N,Pitching up...
1497845.851,HPITCH,N,Pitch commanded from -3.63 cm (689) to 6.26 cm (3853)...
1497847.206,HPITCH,N,-3.4 cm (ad: 778) .....
1497857.981,HPITCH,N,3.4 cm (ad: 2933) ....Pitch motor timeout!
1497863.102,SMOTOR,N,MOTOR_DONE: ticks: 5 max 24v: 3.1mA avg 24v: 2.3mA minv 24v: 23.7v
1497863.259,SMOTOR,N,GC TICKS/TIME: 648/650661
1497863.354,HPITCH,N,done.
1497863.500,HPITCH,C,Pitch completed from -3.63 cm (689) to 6.20 cm (3835) took 16.0 sec 252mA (822mA peak) 23.5vmin 196 AD/sec 640 ticks; 1 errors
1497863.934,HPITCH,N,TRACK: b: 3824/0 a: 3824/0 d: 16 o: 11
1497864.050,SUSR,N,Pitching down...
1497864.254,HPITCH,N,Pitch commanded from 6.20 cm (3835) to -5.53 cm (80)...
1497865.629,HPITCH,N,5.8 cm (ad: 3701) .....
1497876.379,HPITCH,N,-5.2 cm (ad: 182) .MOTOR_DONE: ticks: 17 max 24v: 3.1mA avg 24v: 2.3mA minv 24v: 23.8v
1497877.423,SMOTOR,N,GC TICKS/TIME: 480/482298
1497877.519,HPITCH,N,done.
1497877.665,HPITCH,N,Pitch completed from 6.21 cm (3836) to -5.55 cm (73) took 11.5 sec 66mA (79mA peak) 23.7vmin 327 AD/sec 460 ticks
1497878.068,HPITCH,N,TRACK: b: 94/0 a: 90/0 d: 2 o: -17
1497878.181,SUSR,N,Backing off pitch mass...
1497878.369,HPITCH,N,   Pitch control position = -5.56 cm, (AD#= 72)
1497878.671,HPITCH,N,Pitch commanded from -5.56 cm (72) to -3.56 cm (711)...
1497879.979,HPITCH,N,-3.3 cm (ad: 166) .....MOTOR_DONE: ticks: 10 max 24v: 3.1mA avg 24v: 2.3mA minv 24v: 23.8v
1497883.122,SMOTOR,N,GC TICKS/TIME: 134/136259
1497883.217,HPITCH,N,done.
1497883.365,HPITCH,N,Pitch completed from -5.55 cm (73) to -3.59 cm (700) took 3.0 sec 235mA (292mA peak) 23.5vmin 207 AD/sec 121 ticks
1497883.766,HPITCH,N,TRACK: b: 695/0 a: 698/0 d: 0 o: 2

Figure 7-19. Checking pitch motor

a. At the prompt “Verify pitch SW limits and timeouts? [Y],” press Enter to accept the default (Y) (Figure 7-19).

b. At the prompt “$PITCH_MIN: New value?[x],” verify that the value displayed matches the minimum pitch value on the Cal sheet (found in respective Seaglider notebook) (Figure 7-19).

c. Do one of the following:

- If the minimum pitch value is correct, press Enter to accept the default answer.
- If the minimum pitch value at the prompt differs from the value on the trim sheet, make sure that the trim sheet is up to date. If the trim sheet is the latest version, enter the correct value, and then press Enter.

d. At the prompt “$PITCH_MAX: New value?[x],” verify that the value on the screen matches the maximum pitch value on the Cal sheet (found in respective Seaglider notebook) (Figure 7-19).

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e. Do one of the following:
   - If the maximum pitch value is correct, press Enter to accept the default answer.
   - If the maximum pitch value at the prompt differs from the value on the trim sheet, make sure that the trim sheet is up to date. If the trim sheet is the latest version, enter the correct value, and then press Enter.

f. Do one of the following:
   - If the default value for nominal pitch timeout appears (typical value should be 16 or 17), press Enter.
   - If the nominal value does not appear, enter the value **17** and press Enter.

42. Check the roll motor and values (Figure 7-20).

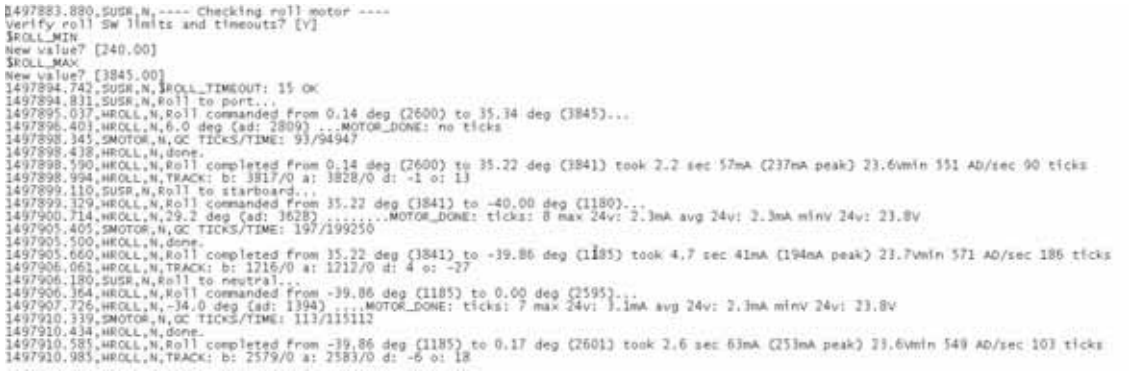

1497883.880,SUSR,N,---- Checking roll motor ----
Verify roll SW limits and timeouts? [Y]
$ROLL_MIN
New value? [240.00]
$ROLL_MAX
New value? [3845.00]
1497894.742,SUSR,N,$ROLL_TIMEOUT: 15 OK
1497894.811,SUSR,N,Roll to port...
1497895.037,HROLL,N,Roll commanded from 0.14 deg (2600) to 35.34 deg (3845)...
1497896.403,HROLL,N,6.0 deg (ad: 2809) ...MOTOR_DONE: no ticks
1497898.345,SMOTOR,N,GC TICKS/TIME: 93/94947
1497898.438,HROLL,N,done.
1497898.590,HROLL,N,Roll completed from 0.14 deg (2600) to 35.22 deg (3841) took 2.2 sec 57mA (237mA peak) 23.6vmin 551 AD/sec 90 ticks
1497898.994,HROLL,N,TRACK: b: 3817/0 a: 3828/0 d: -1 o: 13
1497899.110,SUSR,N,Roll to starboard...
1497899.329,HROLL,N,Roll commanded from 35.22 deg (3841) to -40.00 deg (1180)...
1497900.714,HROLL,N,29.2 deg (ad: 3628) .....MOTOR_DONE: ticks: 8 max 24v: 2.3mA avg 24v: 2.3mA minv 24v: 23.8V
1497901.405,SMOTOR,N,GC TICKS/TIME: 197/199250
1497905.500,HROLL,N,done.
1497905.660,HROLL,N,Roll completed from 35.22 deg (3841) to -39.86 deg (1185) took 4.7 sec 41mA (194mA peak) 23.7vmin 571 AD/sec 186 ticks
1497906.061,HROLL,N,TRACK: b: 1216/0 a: 1212/0 d: 4 o: -27
1497906.180,SUSR,N,Roll to neutral...
1497906.364,HROLL,N,Roll commanded from -39.86 deg (1185) to 0.00 deg (2595)...
1497907.726,HROLL,N,-34.0 deg (ad: 1394) ....MOTOR_DONE: ticks: 7 max 24v: 2.1mA avg 24v: 2.3mA minv 24v: 23.8V
1497910.339,SMOTOR,N,GC TICKS/TIME: 113/115112
1497910.434,HROLL,N,done.
1497910.585,HROLL,N,Roll completed from -39.86 deg (1185) to 0.17 deg (2601) took 2.6 sec 63mA (253mA peak) 23.6vmin 549 AD/sec 103 ticks
1497910.985,HROLL,N,TRACK: b: 2579/0 a: 2583/0 d: -6 o: 18

Figure 7-20. Checking roll motor

a. At the prompt, “Verify roll SW limits and timeouts? [Y],” press Enter to accept the default (Yes) (Figure 7-20).

b. At the prompt “$ROLL_MIN: New value?[x],” verify that the value displayed matches the minimum roll value on the Cal sheet (found in respective Seaglider notebook) (Figure 7-20).
   - If the minimum roll value is correct, press Enter to accept the default.
   - If the minimum roll value at the prompt differs from the value on the Cal sheet, make sure that the Cal sheet is up to date. If the Cal sheet is the latest version, enter the correct value, and then press Enter.

c. At the prompt “$ROLL_MAX: New value?[x],” verify that the value displayed matches the maximum roll value on the Cal Sheet (found in respective Seaglider notebook) (Figure 7-20).
   - If the maximum roll value is correct, press Enter to accept the default answer.
   - If the maximum roll value at the prompt differs from the value on the Cal sheet, make sure that the Cal sheet is up to date. If the Cal sheet is the latest version, enter the correct value, and then press Enter.

d. Do one of the following:
   - If the nominal value of 15 appears, then press Enter.
   - If the nominal value does not appear, enter the value `15` and press Enter.

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43. Check the VBD motor and values (Figure 7-21).


1497911.104,SUSR,N,---- Checking VBD and valve ----
Verify VBD SW limits and timeouts? [Y]
$VBD_MIN
New value? [550.00]
$VBD_MAX
New value? [3959.00]
$VBD_TIMEOUT
New value? [720.00]
1497926.655,MVBD,N,   VBD lin pot AD counts: 632 544
1497926.809,MVBD,N,   VBD bladder position = 591.65 cc, (AD#= 588)
1497927.077,MVBD,N,Bleed commanded from 591.65 cc (588) to 401.06 cc (1365)...
1497938.469,MVBD,N,589.4 cc (ad: 597 [642, 552]) .....
1497939.244,MVBD,N,518.1 cc (ad: 888 [933, 852]) .....
1497950.069,MVBD,N,449.6 cc (ad: 1167 [1208, 1135]) .....MOTOR_DONE: ticks: 9 max 24v: 1076.4mA avg 24v: 123.2mA minv 24v: 23.7V
1497958.534,SMOTOR,N,GC TICKS/TIME: 1211/1213159
1497958.632,MVBD,N,done.
1497958.796,MVBD,N,Bleed completed from 591.65 cc (588) to 400.81 cc (1366 [1400, 1332]) took 30.0 sec 0mA (928mA peak) 23.8vmin 25 AD/sec 1199 ticks
1497959.205,MVBD,N,TRACK: b: 1399/1332 a: 1399/1332 d: -34 o: -33
1497959.372,MVBD,N,   VBD lin pot AD counts: 1400 1332
1497959.528,MVBD,N,   VBD bladder position = 400.81 cc, (AD#= 1366)
1497959.661,SUSR,N,Pumping 100cc on boost alone...
1497959.903,MVBD,N,Pump commanded from 400.81 cc (1366) to 500.89 cc (958)...
1497961.369,MVBD,N,401.3 cc (ad: 1364 [1399, 1327]) .....
1497972.194,MVBD,N,424.4 cc (ad: 1270 [1315, 1223]) .....
1497982.994,MVBD,N,448.4 cc (ad: 1172 [1216, 1126]) .....
1497993.794,MVBD,N,472.9 cc (ad: 1072 [1116, 1027]) .....
1498004.569,MVBD,N,497.2 cc (ad: 973 [1014, 931]) ...MOTOR_DONE: ticks: 9 max 24v: 3.8mA avg 24v: 3.1mA minv 24v: 23.8V
1498006.709,SMOTOR,N,GC TICKS/TIME: 1822/1824116
1498006.807,MVBD,N,done.
1498006.967,MVBD,N,Pump completed from 400.57 cc (1367) to 501.88 cc (954 [996, 913]) took 45.2 sec 111mA (1557mA peak) 23.6vmin 9 AD/sec 1810 ticks
1498007.413,MVBD,N,TRACK: b: 1001/916 a: 1001/916 d: -43 o: -47
1498007.537,SUSR,N,Pumping up to maximum buoyancy...
1498007.781,MVBD,N,Pump commanded from 502.12 cc (953) to 600.98 cc (550)...
1498009.160,MVBD,N,502.9 cc (ad: 950 [990, 907]) .....
1498019.960,MVBD,N,516.7 cc (ad: 851 [895, 810]) .....
1498030.785,MVBD,N,550.2 cc (ad: 757 [798, 714]) .....
1498041.535,MVBD,N,573.7 cc (ad: 661 [704, 617]) .....
1498052.335,MVBD,N,596.6 cc (ad: 568 [609, 525]) ....MOTOR_DONE: ticks: 7 max 24v: 421.5mA avg 24v: 64.3mA minv 24v: 23.7V
1498054.996,SMOTOR,N,GC TICKS/TIME: 1841/1843146
1498055.095,MVBD,N,done.
1498055.356,MVBD,N,Pump completed from 502.12 cc (953) to 601.47 cc (548 [591, 505]) took 45.8 sec 545mA (2805mA peak) 23.1vmin 8 AD/sec 1831 ticks
1498055.696,MVBD,N,TRACK: b: 594/507 a: 594/507 d: -44 o: -46
1498055.819,SUSR,N,Bleeding down 10 cc...
1498055.952,MVBD,N,   VBD lin pot AD counts: 589 502
1498056.105,MVBD,N,   VBD bladder position = 602.20 cc, (AD#= 545)
1498056.373,MVBD,N,Bleed commanded from 602.20 cc (545) to 592.39 cc (585)...
1498057.741,MVBD,N,600.0 cc (ad: 554 [606, 513]) ..MOTOR_DONE: ticks: 8 max 24v: 1076.4mA avg 24v: 138.5mA minv 24v: 23.7V
1498059.376,SMOTOR,N,GC TICKS/TIME: 73/74931
1498059.468,MVBD,N,done.
1498059.631,MVBD,N,Bleed completed from 602.20 cc (545) to 592.14 cc (586 [631, 541]) took 1.5 sec 0mA (927mA peak) 23.8vmin 26 AD/sec 62 ticks
1498060.027,MVBD,N,TRACK: b: 630/540 a: 631/540 d: -46 o: -45
0.260,SSURF,N,Initializing data file
0.542,SSURF,N,Initializing log file

Figure 7-21. Checking VBD motor and value

a. At the prompt “Verify VBD SW limits and timeouts? [Y],” press Enter to accept the default (Yes) (Figure 7-21).

b. At the prompt “$VBD_MIN: New value?[x],” verify that the value displayed matches the minimum VBD value on the Cal Sheet (found in respective Seaglider notebook) (Figure 7-21).

   - If the minimum VBD value is correct, press Enter to accept the default answer.
   - If the minimum VBD value at the prompt differs from the value on the Cal sheet, make sure that the Cal sheet is up to date. If the Cal sheet is the latest version, enter the correct value, and then press Enter.

c. At the prompt “$VBD_MAX: New value?[x],” verify that the value displayed matches the maximum VBD value on the Cal Sheet (found in respective Seaglider notebook) (Figure 7-21).

   - If the maximum VBD value is correct, press Enter to accept the default answer.
   - If the maximum VBD value at the prompt differs from the value on the Cal sheet, make sure that the Cal sheet is up to date. If the Cal sheet is the latest version, enter the correct value, and then press Enter.

d. Do one of the following:

   - If the nominal value of 720 for VBD timeout appears, then press Enter.
   - If the nominal value does not appear, enter the value `720` and press Enter.

44. Seaglider runs a self test on the sensors (both flight and science) and the pitch, roll and VBD systems and displays the data to the screen (Figure 7-22). With the exception of heading values fluctuating around zero when Seaglider is pointing north, the numbers should be nonzero. If the values look OK, press Enter to continue.

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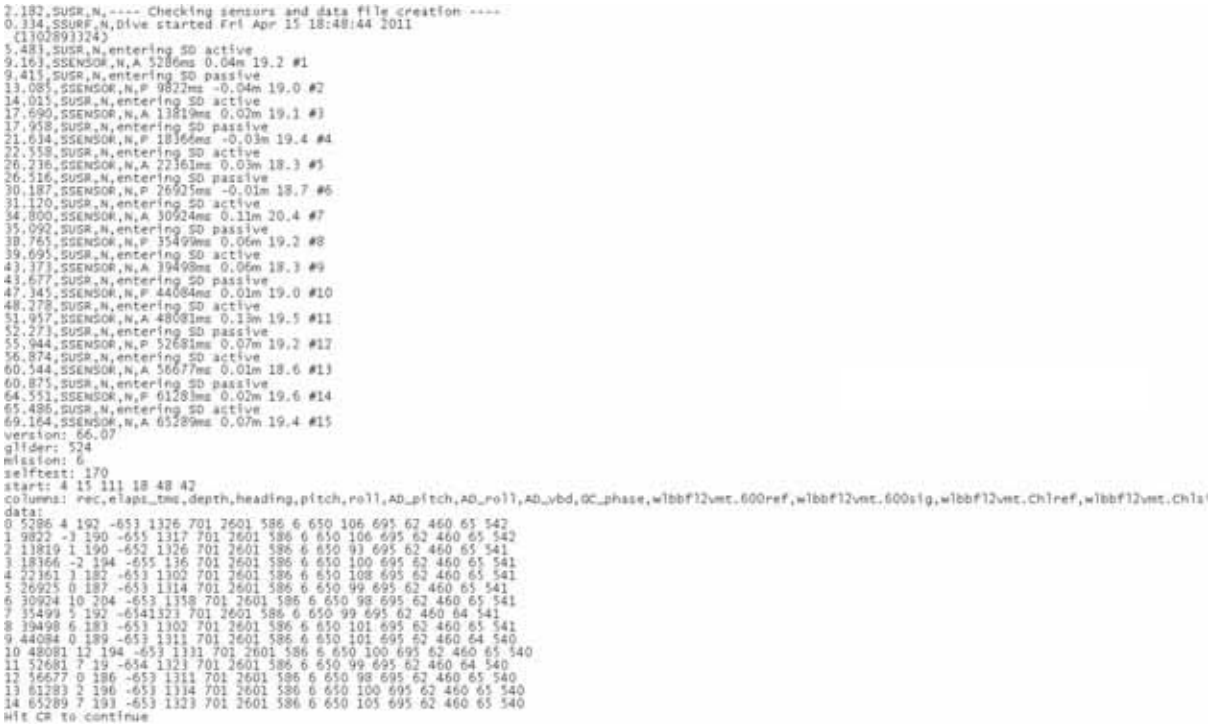


Figure 7-22. Checking sensors and data file creation

45. The glider will now report its internal pressure and humidity.

    Generally if the internal pressure is around 1 atmospheric pressure, 14.7 psi, a vacuum was not pulled. If a vacuum was pulled, the internal pressure should be approximately 5 psi below atmospheric pressure (or 10 psi). Humidity values would typically range between 30-40%.

    If a vacuum was pulled, high internal pressure indicates a potentially dangerous problem. If the pressure inside the pressure hull rises 4psia above whatever the pressure is outside the pressure hull, the vent plug on the aft end cap opens to vent internal gasses.

    If the prompt “Internal pressure is high. Continue self-test? [N]” appears, press Enter to accept No (default) (Figure 7-23). Seaglider has failed the self test.

WARNING:
Before moving Seaglider, understand what is causing the high pressure and determine if it is safe to go near it.


80.681,SUSR,N,---- writing internal sensors to log ----
81.208,SUSR,N,Internal humidity 1519 counts (34.000003%RH)
81.416,SUSR,N,Internal pressure 9.607714 psia

Figure 7-23. Internal pressure and humidity sensors

46. If the message “Sensor idx [x] not found in installed sensors!” appears, it indicates that there are sensors in slots [0] through [x-1]. Verify the number of installed sensors in the respective Seaglider notebook.

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For example, if the message Sensor idx 3 not found in installed sensors! appears, this indicates there are sensors in slot 0, slot 1, and slot 2, creating a total of 3 installed sensors (CT, DO, and Optics 1). If the number of sensors Seaglider says are installed differs from what is listed in the respective Seaglider notebook, the discrepancy needs to be understood and corrected. The self test result is a fail until the error is corrected.

47. The altimeter and transponder checks appear (Figure 7-24).If any error is present the self test fails. Determine the problem with the altimeter/transponder and correct before proceeding. Note that the altimeter/transponder does not always get a response in air.

```
81.516,SUSR,N,---- Checking altimeter ----
81.971,HXPDR,N,ping response: R005.031ms

82.034,HXPDR,N,range was 3.773250 m
82.165,SUSR,N,---- Checking transponder ----
82.951,HXPDR,N,Tried 1 times to respond to command $T

83.054,SUSR,N,transponder reply ping count=-1
```

Figure 7-24. Checking altimeter

48. The glider will now report the list of targets from the currently loaded targets file and the settings from the currently loaded science file (Figure 7-25).

```
83.159,SUSR,N,---- Reporting targets and science specifications ----
86.385,SNAV,N,      Target      Latitude  Longitude    Radius Depth Finish Timeout Next target Escp target
86.731,SNAV,N,      NW          4744.400  -12224.500    200.0m     0  -1   0.0 NE none
87.048,SNAV,N,  => NE          4744.400  -12223.700    200.0m     0  -1   0.0 SE none
87.365,SNAV,N,      SE          4743.000  -12223.700    200.0m     0  -1   0.0 SW none
87.682,SNAV,N,      SW          4743.000  -12224.500    200.0m     0  -1   0.0 NW none
87.998,SNAV,N,      T           4745.500  -12224.200    200.0m     0  -1   0.0 C1 none
88.315,SNAV,N,      C1          4744.200  -12223.600    200.0m     0  -1   0.0 B none
88.630,SNAV,N,      B           4743.100  -12223.600    200.0m     0  -1   0.0 C2 none
88.947,SNAV,N,      C2          4744.200  -12223.600    200.0m     0  -1   0.0 T none
89.822,SSENSOR,N,   Depth        Time       GSC Sensors
90.013,SSENSOR,N,    15.0m       5.0s      60.0s 1 (WL_BBFL2vMT: 1)
90.266,SSENSOR,N,    50.0m      10.0s     120.0s 1 (WL_BBFL2vMT: 1)
90.525,SSENSOR,N,   150.0m      15.0s     120.0s 1 (WL_BBFL2vMT: 1)
```

Figure 7-25. Reporting targets and science specifications

49. Next, the glider will report the battery status/voltage as well as individual fuel gauges for all motors, sensors, and the main processor (Figure 7-26).

```
85.615,SUSR,N,---- Reporting battery status ----

89.866,SPOWER,N,------ Fuel gauges (Cumulative Amp-secs) -------

                        cumulative      / since power up
90.151,SPOWER,N,          Pitch_motor:    17.29 amp-sec /    27.77 sec
90.311,SPOWER,N,           Roll_motor:     1.14 amp-sec /     6.85 sec
90.519,SPOWER,N,    VBD_pump_during_apogee:    45.86 amp-sec /     0.00 sec
90.761,SPOWER,N,    VBD_pump_during_surface:   565.23 amp-sec /   312.85 sec
90.917,SPOWER,N,              VBD_value:     0.00 amp-sec /     0.00 sec
91.099,SPOWER,N,      Iridium_during_init:    34.50 amp-sec /     0.00 sec
91.286,SPOWER,N,    Iridium_during_connect:   122.36 amp-sec /     0.00 sec
91.904,SPOWER,N,      Iridium_during_xfer:   285.46 amp-sec /     0.00 sec
92.099,SPOWER,N,         Transponder_ping:     4.51 amp-sec /     1.80 sec
92.252,SPOWER,N,              GUMSTIX_24V:     0.00 amp-sec /     0.00 sec
92.428,SPOWER,N,       ------------ 24V total = 0.299 AmpHr -----------
92.631,SPOWER,N,                     GPS:     9.12 amp-sec /    65.16 sec
92.847,SPOWER,N,                     TT8:    40.84 amp-sec /    99.35 sec
93.050,SPOWER,N,                  LPSleep:     0.78 amp-sec /     1.90 sec
93.269,SPOWER,N,              TT8_Active:    29.28 amp-sec /   151.58 sec
93.492,SPOWER,N,            TT8_Sampling:   116.30 amp-sec /   179.32 sec
93.707,SPOWER,N,                 TT8_CF8:    13.07 amp-sec /    32.80 sec
93.882,SPOWER,N,              TT8_Kalman:     1.73 amp-sec /     0.00 sec
94.102,SPOWER,N,          Analog_circuits:    28.83 amp-sec /   195.45 sec
94.255,SPOWER,N,          GPS_charging:     0.00 amp-sec /     0.00 sec
94.463,SPOWER,N,                 Compass:     7.84 amp-sec /    55.24 sec
94.615,SPOWER,N,                   RAFOS:     0.00 amp-sec /     0.00 sec
94.814,SPOWER,N,             Transponder:     0.68 amp-sec /     7.03 sec
94.967,SPOWER,N,                Compass2:     0.00 amp-sec /     0.00 sec
95.182,SPOWER,N,              WL_BBFL2vMT:    43.78 amp-sec /    49.64 sec
95.406,SPOWER,N,                    GPCTD:  3021.56 amp-sec /    65.44 sec
95.584,SPOWER,N,       ------------ 10V total = 0.926 AmpHr ------------
95.942,HBATT,N,24V batt pack voltage = 26.24v
96.077,HBATT,N,10V batt pack voltage = 10.85v
```

Figure 7-26. Battery status/fuel gauges

If running off external power, a message will appear that battery consumption is not being tracked.

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50. Verify that the gauge is working properly:

    The right column is the cumulative number of the seconds each system has been on since the battery packs were replaced.

    The gauge is working properly if the time (sec) in the right column (since power up) is reading mostly non-zero values while Seaglider is running on battery power.

    If Seaglider is running on bench power, all values in the right column are near zero. If the right column reads all zeros while Seaglider is on battery power, the self test fails.

    Determine the problem with the battery packs before proceeding.

51. The battery voltage display shows the amount of battery voltage left in the 10V and 24V battery packs.

    If prompted “Battery voltage is low. Continue Self Test? [N],” do one of the following:

    - If this self test is just before a planned launch, press Enter to accept the default answer, No. The self test fails.
    - Otherwise, type Y and press Enter, if it is safe to do so.

    NOTE: Often, if Seaglider is attached to the powered comms, the battery voltage appears out of range.

52. The capture file check settings are checked and the findings are displayed (Figure 7-27).

```
99.141,SUSM,N,---- Checking capture vector ----
99.648,SUSM,N,all capture settings at default values
```

Figure 7-27. Checking capture vector

53. Seaglider runs a self test on the persistor CF2 flashcard (Figure 7-28). If an error is detected, the self test fails. Determine the cause of the failure and correct before continuing.

```
105.901,SUSM,N,---- Checking flash ----
No flash problems detected
```

Figure 7-28. Checking flash

54. When prompted to perform the communications check, press Enter to accept the default answer Yes (Y).

    Seaglider:

    - Makes an Iridium call to the basestation.
    - Downloads any files waiting for it on the basestation.
    - Uploads the data files it has generated during the self test.

    A message appears reporting the success or failure of the communication and transmission session (Figure 7-29). If the transmission fails, then the Iridium phone test fails and the self test fails.

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Reposition Seaglider to be sure its antenna has an unobstructed view of the sky and wait for it to make another phone call.

```
371.501,SSURF,N,Trying call 1...
371.545,SSURF,N,Calling phone number: 6975087483006
373.654,HPHONE,N,Initializing PSTN connection
396.647,HPHONE,N,Iridium signal strength: 5
396.812,HPHONE,N,Iridium geolocation: 41.729992 -71.595558 Wed Feb  9 16:08:54 2011
438.284,SSURF,N,Logged in...
439.544,SSURF,N,Sending cmd lsx -k -t150 cmdfile
443.668,SSURF,N,Receiving cmdfile...
444.934,SSURF,N,SOH/STX: 0x1 received (1), secSize= 128...
448.779,SSURF,N,SOH/STX: 0x1 received (1), secSize= 128...
450.107,SSURF,N,SOH/STX: 0x1 received (1), secSize= 128...
451.837,SSURF,N,SOH/STX: 0x1 received (1), secSize= 128...
453.368,SSURF,N,SOH/STX: 0x1 received (1), secSize= 128...
454.898,SSURF,N,SOH/STX: 0x1 received (1), secSize= 128...
456.338,SSURF,N,EOT: 0x4 received (1), secSize= 128...

457.086,SSURF,N,Received cmdfile 709 bytes
457.517,SSURF,N,Transmission succeeded...
```

Figure 7-29. Iridium communications and transmission check

55. The pass/fail status of the self test is displayed. If the self test FAILED or ABORTED, the failures are listed. In the example in Figure 7-30, self test failed because there were no bathymetric maps of the current location onboard Seaglider. Since Seaglider was on land, this error can be ignored.

    Sometimes there will be an Iridium failure due to an inability to register at the beginning of the test because the time allotted for the phone registration is very short. If the Seaglider was able to successfully transfer data files at the end of the self test, this error can be ignored.

```
1015.236,SUSR,N,---- Self test FAILED or ABORTED! ----
1015.345,SUSR,N,1 failures noted
1015.425,SUSR,N,--> bathymetry maps failed
1015.521,SUSR,N,Restoring original settings...
```

Figure 7-30. Self test pass/fail status

56. Review the files (.log, .cap) sent to the basestation via the Iridium call and the comm.log file for any warnings or errors.

    At a minimum, the pilot and preferably one other person should perform this review.

    For more information about reviewing piloting tasks, see Chapter 6, “Predeployment Tasks” on page 107.

Table 7-1. Actions following review of self test

Result of self test	Action
There are no warnings or errors seen in any of the files (expected outcome)	Test is complete. You can • Launch Seaglider (see Chapter 6, “Predeployment Tasks”). • Perform a series of simulated dives (see “Simulated dives” on page 157). • Wand off Seaglider and put it away. (Go to the next step.)
There is a problem during the testing; the final lines from the self test show that the self test failed or was aborted, or the data and log files were not transferred to the basestation.	Find the problem (see Chapter 6, “Predeployment Tasks”).

NOTE: Whether the self test passes or fails, the Launch Menu appears.

If your Seaglider is equipped with a GPCTD, continue with step 57; otherwise skip to step 58.

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57. IMPORTANT: You must turn the pump for the GPCTD back on, prior to deploying in water on a data-gathering mission (Figure 7-31).

Figure 7-31. Loggers menu.


------ Main Menu ------
1 [param] Parameters and configuration
2 [hw] Hardware tests and monitoring
3 [modes] Test operation modes and files
4 [pdos] PicoDOS commands (and exit)
5 [launch] Pre-launch
Enter selection (1-5,CR): 2
------ Hardware Menu ------
*Motors and VBD
1 [pitch] Pitch control
2 [roll] Roll control
3 [vbd] VBD control
*Fixed Devices
4 [super] Supervisor
5 [pressure] Pressure sensor
6 [compass] Compass (tcm2)
7 [gps] GPS
8 [modem] Modem (xmodem mode)
9 [intpress] Internal pressure
10 [altim] Altimeter
11 [sensors] Sensors
12 [loggers] Loggers
*Other
13 [batt] Batteries and fuel gauges
14 [lowlevel] Low-level hardware (IO,A-D,CF)
15 [misc] Miscellaneous (travel, timeouts, date/time)
16 [develop] Developer tests
CR) Return to previous
Enter selection (1-16,CR): 12
------ Loggers menu ------
1 [pc] GPCTD
2 [ ] empty
CR) Return to previous
Enter selection (1-2,CR): 1

a. Press Enter until you return to the Main menu (Figure 7-31).
b. Press **2** and press Enter to enter the Hardware menu (Figure 7-31).
c. Press **12** and press Enter to enter the Loggers menu (Figure 7-31).
d. Press **1** and press Enter to enter the GPCTD menu (Figure 7-31).

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e. Press **11** and press Enter to go into direct serial communications with the GPCTD (Figure 7-32).

```
------ Logger device test menu ------
     1 [on      ]  Turn on
     2 [off     ]  Turn off
     3 [selftest]  Selftest
     4 [sample  ]  Report a sample
     5 [syncclk ]  Synchronize device clock to TT8
     6 [clock   ]  Read device clock
     7 [file    ]  Get file from device
     8 [action  ]  Execute logger action
     9 [config  ]  Show configuration
    10 [edit    ]  Edit configuration
    11 [direct  ]  Direct comms
    CR)  Return to previous
Enter selection (1-11,CR): 11
35.883,HGPCTD,N,RX = 10, TX = 11
36.579,SUSR,N,Starting breakable loop - Ctrl-Q to end

S>GetCD
<ConfigurationData DeviceType = 'SBE Glider Payload CTD' SerialNumber = '70100016'>
   <SampleDataFormat>HEX engineering</SampleDataFormat>
   <RS232ForceOn>yes</RS232ForceOn>
   <TxRealTime>no</TxRealTime>
   <SampleInterval>1</SampleInterval>
   <SampleMode>Continuous</SampleMode>
   <AutoRun>no</AutoRun>
   <SBE43>yes</SBE43>
   <MinCondFreq>10000</MinCondFreq>
   <CustomPumpMode>no</CustomPumpMode>
</ConfigurationData>
S>minCondFreq=3212.0
S>GetCD
<ConfigurationData DeviceType = 'SBE Glider Payload CTD' SerialNumber = '70100016'>
   <SampleDataFormat>HEX engineering</SampleDataFormat>
   <RS232ForceOn>yes</RS232ForceOn>
   <TxRealTime>no</TxRealTime>
   <SampleInterval>1</SampleInterval>
   <SampleMode>Continuous</SampleMode>
   <AutoRun>no</AutoRun>
   <SBE43>yes</SBE43>
   <MinCondFreq>1212.0</MinCondFreq>
   <CustomPumpMode>no</CustomPumpMode>
</ConfigurationData>
S>start
<!--start logging-->
S>    0.08, 15.4768, 0.00004
     0.09, 15.4771, 0.00004
     0.08, 15.4770, 0.00003
     0.07, 15.4778, 0.00003
     0.08, 15.4787, 0.00003
     0.08, 15.4788, 0.00003
     0.09, 15.4789, 0.00003
     0.09, 15.4798, 0.00003
     0.07, 15.4797, 0.00003
     0.08, 15.4799, 0.00003
     0.08, 15.4808, 0.00003
     0.08, 15.4811, 0.00003

<logging stopped/>

S>
------ Logger device test menu ------
     1 [on      ]  Turn on
     2 [off     ]  Turn off
     3 [selftest]  Selftest
     4 [sample  ]  Report a sample
     5 [syncclk ]  Synchronize device clock to TT8
     6 [clock   ]  Read device clock
     7 [file    ]  Get file from device
     8 [action  ]  Execute logger action
     9 [config  ]  Show configuration
    10 [edit    ]  Edit configuration
    11 [direct  ]  Direct comms
    CR)  Return to previous
Enter selection (1-11,CR): 2
```

Figure 7-32. Set MinCondFreq

f. Press Enter until a 'S>' prompt appears (Figure 7-32).

g. Type `MinCondFreq=X` where X is the number recorded when you followed the steps to disable the pump before, and press Enter. (Figure 7-32).

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Figure 7-33 shows some additional settings for MinCondFreq.



SEA-BIRD ELECTRONICS, INC.
13431 NE 20th Street, Bellevue, Washington, 98005-2010 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0017
CALIBRATION DATE: 07-Dec-10

SBE GLIDER PAYLOAD CTD
CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -1.006405e+000
h = 1.720007e-001
i = -4.860079e-004
j = 6.696523e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 4.1244e-007

BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2424.44	0.00000	0.00000
1.0000	34.5544	2.95570	4810.56	2.95570	-0.00001
4.5000	34.5343	3.26073	4991.87	3.26073	0.00001
15.0000	34.4915	4.23596	5531.14	4.23597	0.00000
18.5000	34.4824	4.57883	5708.39	4.57882	-0.00001
24.0000	34.4717	5.13300	5983.50	5.13300	-0.00000
29.0000	34.4652	5.65125	6229.49	5.65125	0.00001
32.5000	34.4611	6.02101	6399.03	6.02101	-0.00000

Figure 7-33. Example excerpt from GPCTD cal sheet

- Find the numbers circled in Figure 7-33 where Siemens/m is 0 indicating freshwater response.
- The frequency circled in red, 2424.44 Hz, is the number needed from the SBE cal sheet for this particular unit.
- For saltwater and estuarine applications, SBE recommends the value circled above + 500 Hz. So, for the example in Figure 7-33, the desired MinCondFreq would be 2924 Hz.
- For fresh/nearly fresh water application the typical recommended MinCondFreq is equal to the zero conductivity raw frequency + 5 Hz.

Contact iRobot if there are any questions on what this value should be for your unit.

h. Type `GetCD` and press Enter (Figure 7-32).
   - Find the value labeled MinCondFreq and confirm it has been reset to the value it was before the first half of this process was run.

i. Type `Start` and press Enter (Figure 7-32).
   - Confirm the pump is running if the value you entered was 0.

     The pump may not run if the value is non-zero.

j. Type `Stop` and press Enter to stop system and get prompt back. You will not see the word "Stop" displayed – but a message will appear that the "logging stopped" (Figure 7-32).

k. Press Ctrl-Q to exit direct communications with the GPCTD (Figure 7-32).

l. Once back at the GPCTD menu, type **2** and press Enter to turn off the GPCTD.

m. Press Enter until you return to the main menu and wand off the Seaglider before continuing onto other tasks.

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58. Turn off Seaglider:
    a. Move the magnetic wand over the OFF symbol on the port side of Seaglider about 20" aft of the nose for at least 0.5 seconds. Make sure that the wand is touching the fairing.
    b. While moving the wand over the OFF symbol press, or have someone else press, Enter on the laptop keyboard.
    c. Continue moving the wand around the OFF symbol and pressing Enter until the laptop screen shows no response to pressing Enter.
59. Disconnect the communication cable from Seaglider and the laptop and reinstall the dummy plug on the communication connector on Seaglider.
60. If it is easier to store or move Seaglider in its cradle without the antenna mast attached, you can detach it (leave the cables attached to aft end cap) (see “Detaching the antenna mast from aft fairing” on page 117).
61. Stow Seaglider.

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Simulated dives

Simulated dives are so named because they are done without Seaglider being in the water. They should be done outside so that the antenna mast has a clear view of the sky. Simulated pressure and pitch observations (**$SIM_W** and **$SIM_PITCH,** respectively) are used to complete test dives.

This is a valuable way to test the end-to-end data path, because the basestation is not only involved but has to deal with bi-directional file transmission multiple times. The operator can do as few, or as many, simulated dives as they would like. iRobot recommends that at least 5 are done prior to deployment.

Locate and move files to directory

To run simulated dives, the pilot needs to first make sure that files generated by Seaglider and transferred to the basestation at an earlier time (that is, during the previously completed interactive self test) are preserved on the basestation, but not in the main directory.

1. On the basestation, enter `cd /home/sgNNN` (the home directory)

   where

   NNN = the Seaglider serial number.

2. If there are files in the Seaglider home directory from a past mission or test, type the following command to move the files (longhand method), and then press Enter:

   ```
   /usr/local/basestation/movedata.sh -mission_dir <source_dir> -t
   target_dir>
   ```

   If you are in the Seaglider home directory and want to move the files to a subdirectory of that home directory, type the following command (shorthand method), and then press Enter:

   ```
   movedata.sh subdirectory_filename
   ```

   The follwing examples show some subdirectory naming convention:

   - **Selftest_17May06** (after self test completed).
   - **Simulated dive_17May06** (after simulated dive completed).
   - **PortSusan_17May06** (after open water run in Port Susan).

   If the directory for that Seaglider does not exist on the basestation, for more information, see “Setting up the basestation directories and files” on page 8.

3. Edit the command file (.cmdfile) and possibly the targets file (.targets), the science file (.science) and the pagers file (.pagers) for the simulated dives.

   These files are located on the basestation in the home directory of the Seaglider about to do the simulation.

   To edit the files for the simulated dives:

   a. Using any file editor, open the command file (cmdfile) and add or change the following parameters:

      $SIM_W,0.1

      $SIM_PITCH,-20

      $D_TGT,30

      $T_DIVE,10

      $T_MISSION,15

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$KALMAN_USE,2

$SM_CC,150

$MAX_BUOY,5

$USE_BATHY,0

$T_RSLEEP,1

$C_VBD,*value provided in notebook or on CD*

$C_PITCH,*value provided in notebook or on CD*

$C_ROLL_DIVE,*value provided in notebook or on CD*

$C_ROLL_CLIMB,*value provided in notebook or on CD*

$GO

b. Save the changes.

c. Using any file editor, open the targets file (targets) and put in one or two latitude/longitude values.

The format of the file looks like the following example:

/ Simple targets

SEVEN lat=4807.0 lon=-12223.0 radius=200 goto=SIX

SIX lat=4806.0 lon=-12222.0 radius=200 goto=SEVEN

For more detail on targets files, see Appendix B, “Seaglider File Formats Manual” on page 201.

d. Save the changes.

e. Using any file editor, open the science file (science) and make sure that the sensors installed on Seaglider are represented in the file. Also check the sampling rate. Since this test is usually done on battery power, the sampling rate is often reduced to cut down on battery usage.

The format of the file looks like the following example..

// Science for Port Susan

/edit for Individual Seaglider w/: CT, SBE-43F oxy, WET Labs BB2FL-VMT

/depth	time	sample	gcint
10	4	122	60
40	4	144	120

For more detail on targets files, see Appendix B, “Seaglider File Formats Manual” on page 201.

f. Save the changes.

g. Using any file editor, open the .pagers file to edit the notification system provided by the .pagers file. The .pagers file controls the automatic email, pager and text message notification system. The file allows any of four types of messages (gps, alerts, recov, comp) to be sent to any valid email address or phone number. This service is run by the data conversion script, which is invoked by a Seaglider logout or disconnection.

Lines beginning with a # are comment lines and are ignored in processing. The gps message is sent after every connection and is the most recent GPS position. The alerts message is sent when the basestation has a problem converting a file or files. The file may be corrupt and have

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to be resent by Seaglider to the basestation using the pdoscmds.bat file (see Appendix C, “Extended PicoDOS® Reference Manual, v66.07” on page 233).

The recov message is sent when Seaglider goes into recovery mode. This message includes the most recent GPS position and the recovery mode reason.

The `comp message` tells the pilot what files completed processing on the basestation.

An example .pagers file is below. For an additional example, see Appendix B, “Seaglider File Formats Manual” on page 201.

Examples:
#
Setting up an email account for gps, alerts, recov, comp
#someone@mydomain.edu,gps,alerts,recov,comp
#
Setting up a phone for gps updates only
#6175551212@cingularME.com,gps
#
##Setting up an ATT phone for gps, alerts, recov, comp
#6175551212@cingularME.com,gps,alerts,recov
##Note the address for each phone service (that is, ATT, Verizon) differs

For a real contact address remove the #.

4. If Seaglider is not outside, assembled, communication cable attached and the antenna pointing up within 40° of vertical with an unobstructed view of the sky, do that now (Figure 7-34).

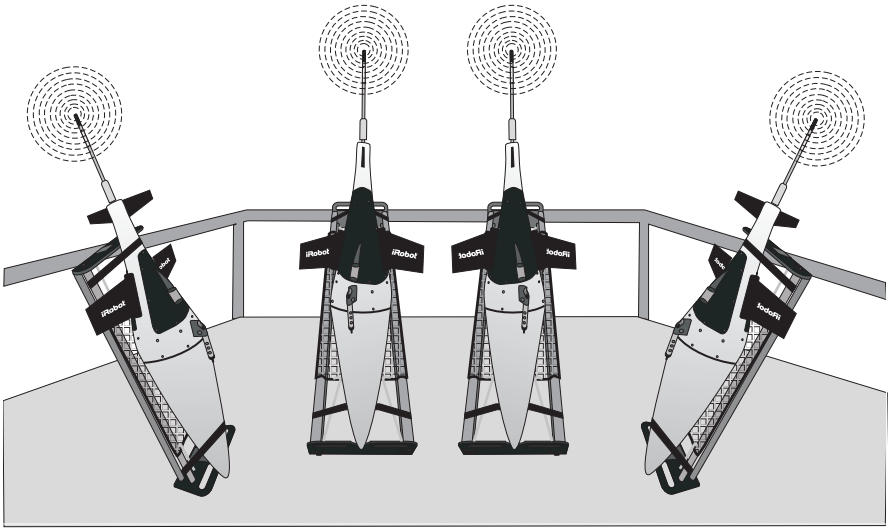


Figure 7-34. Position of Seaglider during a simulated dive

5. If the laptop is not already on and a terminal emulator running, do that now.
6. Open a screen capture or log file.
7. Connect the communication cable to the DB9 connector on the laptop (Figure 7-1).

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8. Wand on Seaglider (see Chapter 3, “Checking Seaglider communication with the field laptop” , page 21.
9. When the output starts scrolling on the laptop, press **Enter** within one minute (Figure 7-35).

   Do the following steps, watch the process on the laptop, and note if there are any errors or warnings during the test. The screen capture file can also be checked at the end of the test for warnings and errors.

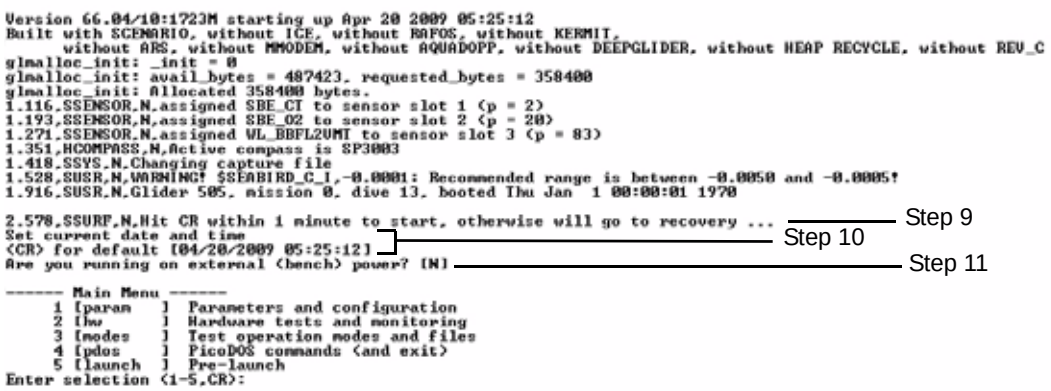

Version 66.04/10:1723M starting up Apr 20 2009 05:25:12
Built with SCENARIO, without ICE, without RAFOS, without KERMIT,
without ARS, without MMODEM, without AQUADOPP, without DEEPGLIDER, without HEAP RECYCLE, without REV_C
glmalloc_init: _init = 0
glmalloc_init: avail_bytes = 487423, requested_bytes = 358400
glmalloc_init: Allocated 358400 bytes.
1.116,SSENSOR,N,assigned SBE_CT to sensor slot 1 (p = 2)
1.193,SSENSOR,N,assigned SBE_O2 to sensor slot 2 (p = 20)
1.271,SSENSOR,N,assigned WL_BBFL2VMT to sensor slot 3 (p = 83)
1.351,HCOMPASS,N,Active compass is SP3003
1.418,SSYS,N,Changing capture file
1.528,SUSR,N,WARNING! $SEABIRD_C_I,-0.0001: Recommended range is between -0.0050 and -0.0005!
1.916,SUSR,N,Glider 505, mission 0, dive 13, booted Thu Jan 1 00:00:01 1970
2.578,SSURF,N,Hit CR within 1 minute to start, otherwise will go to recovery ...
Set current date and time
(CR) for default [04/20/2009 05:25:12]
Are you running on external (bench) power? [N]
Step 9
Step 10
Step 11
------ Main Menu ------
1 [param] Parameters and configuration
2 [hw] Hardware tests and monitoring
3 [modes] Test operation modes and files
4 [pdos] PicoDOS commands (and exit)
5 [launch] Pre-launch
Enter selection (1-5,CR):

Figure 7-35. Seaglider start-up on the laptop

10. Set the current date and time (GMT).

    Press Enter to accept the default value if that value is any time within 12 hours of actual time because Seaglider gets an accurate time later during the simulated dive from its first GPS fix and resets the internal clock (Figure 7-35).

    NOTE: The format must be **mm/dd/yyyy hh:mm:ss**, with no missing values or extra spaces.

11. At the prompt “Are you running on external (bench) power?,” type **Y** (for Yes) to indicate that you have an external power source (on powered comms cable); otherwise press Enter to accept the default answer **N** (for No). (Figure 7-35)

    The Main Menu appears.

    Figure 7-36 shows the Main menu for 1KA Seaglider testing.

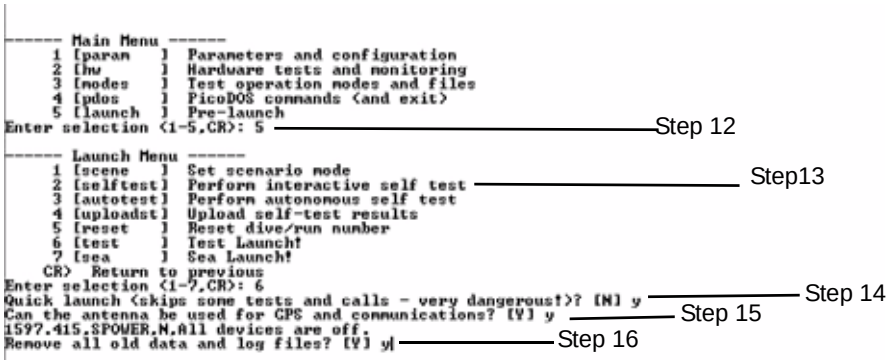

------ Main Menu ------
1 [param] Parameters and configuration
2 [hw] Hardware tests and monitoring
3 [modes] Test operation modes and files
4 [pdos] PicoDOS commands (and exit)
5 [launch] Pre-launch
Enter selection (1-5,CR): 5
Step 12
------ Launch Menu ------
1 [scene] Set scenario mode
2 [selftest] Perform interactive self test
3 [autotest] Perform autonomous self test
4 [uploadst] Upload self-test results
5 [reset] Reset dive/run number
6 [test] Test Launch!
7 [sea] Sea Launch!
CR) Return to previous
Step13
Enter selection (1-7,CR): 6
Quick launch (skips some tests and calls - very dangerous!)? [N] y
Step 14
Can the antenna be used for GPS and communications? [Y] y
Step 15
1597.415,SPOWER,N,All devices are off.
Remove all old data and log files? [Y] y
Step 16

Figure 7-36. Main menu and Launch menu

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12. Type **5**: Pre-Launch, and press Enter (Figure 7-36).
13. Type **6**: test Launch, and press Enter (Figure 7-36).
14. At the prompt “Quick Launch (skips some tests and calls - very dangerous if Seaglider is in the water!) [N],” type **Y** and then press Enter (Figure 7-36).
15. At the prompt “Can the antenna be used for GPS and Communications? [Y],” press **Enter** to accept the default, Y (for Yes) (Figure 7-36).
16. At the prompt “Remove all old data and log files? [Y],” press Enter to accept the default (Y for Yes). Beware, selecting ‘Yes’ removes all data files still on Seaglider from prior missions and tests. Be sure that those files are saved elsewhere BEFORE selecting ‘Yes’. If it is unknown whether the files have been saved, select N (Figure 7-36).

    Seaglider performs pitch, roll, and pump (VBD maneuvers) and displays their movement on the laptop (Figure 7-37)

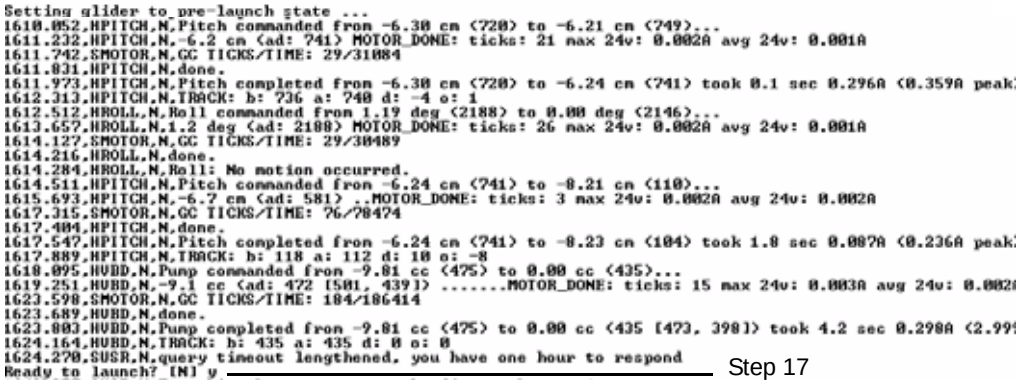

Setting glider to pre-launch state ...
1610.052,HPITCH,N,Pitch commanded from -6.30 cm (720) to -6.21 cm (749)...
1611.232,HPITCH,N,-6.2 cm (ad: 741) MOTOR_DONE: ticks: 21 max 24v: 0.002A avg 24v: 0.001A
1611.742,SMOTOR,N,GC TICKS/TIME: 29/31084
1611.831,HPITCH,N,done.
1611.973,HPITCH,N,Pitch completed from -6.30 cm (720) to -6.24 cm (741) took 0.1 sec 0.296A (0.359A peak)
1612.313,HPITCH,N,TRACK: b: 736 a: 740 d: -4 o: 1
1612.512,HROLL,N,Roll commanded from 1.19 deg (2188) to 0.00 deg (2146)...
1613.657,HROLL,N,1.2 deg (ad: 2188) MOTOR_DONE: ticks: 26 max 24v: 0.002A avg 24v: 0.001A
1614.127,SMOTOR,N,GC TICKS/TIME: 29/30489
1614.216,HROLL,N,done.
1614.284,HROLL,N,Roll: No motion occurred.
1614.511,HPITCH,N,Pitch commanded from -6.24 cm (741) to -8.21 cm (110)...
1615.693,HPITCH,N,-6.7 cm (ad: 581) ..MOTOR_DONE: ticks: 3 max 24v: 0.002A avg 24v: 0.002A
1617.315,SMOTOR,N,GC TICKS/TIME: 76/78474
1617.404,HPITCH,N,done.
1617.547,HPITCH,N,Pitch completed from -6.24 cm (741) to -8.23 cm (104) took 1.8 sec 0.087A (0.236A peak)
1617.889,HPITCH,N,TRACK: b: 118 a: 112 d: 10 o: -8
1618.095,HVBD,N,Pump commanded from -9.81 cc (475) to 0.00 cc (435)...
1619.251,HVBD,N,-9.1 cc (ad: 472 [501, 439]) ....MOTOR_DONE: ticks: 15 max 24v: 0.003A avg 24v: 0.002
1623.598,SMOTOR,N,GC TICKS/TIME: 184/186414
1623.689,HVBD,N,done.
1623.803,HVBD,N,Pump completed from -9.81 cc (475) to 0.00 cc (435 [473, 398]) took 4.2 sec 0.298A (2.99
1624.164,HVBD,N,TRACK: b: 435 a: 435 d: 0 o: 0
1624.270,SUSR,N,query timeout lengthened, you have one hour to respond
Ready to launch? [N] y
Step 17

Figure 7-37. Pitch, roll, and pump maneuvers

17. At the prompt “Ready to launch? [N],” type Y (for Yes), and then press Enter (Figure 7-37).
18. At the prompt “Reset dive/run number to:[0],” type **1** or a number of your choosing, and then press Enter (Figure 7-38).

    NOTE: If you chose not to remove old data and log files, select a number that does not overlap those already present.

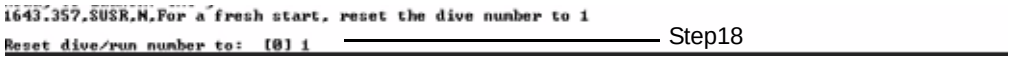


Figure 7-38. Reset dive/run number

19. Verify that Seaglider logs in. Then watch as the parameters (cmdfile), science and targets files are uploaded.

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While the files are uploading, the laptop display looks like Figure 7-39.

Step 19

```
132.383,SSURF,N,Logged in...
134.022,SSURF,N,Sending cmd lsx -k -t150 cmdfile
137.437,SSURF,N,Receiving cmdfile...
138.592,SSURF,N,SOH/STX: 0x1 received, secSize= 128...
140.213,SSURF,N,SOH/STX: 0x1 received, secSize= 128...
141.653,SSURF,N,SOH/STX: 0x1 received, secSize= 128...
143.182,SSURF,N,SOH/STX: 0x1 received, secSize= 128...
144.712,SSURF,N,SOH/STX: 0x1 received, secSize= 128...
146.245,SSURF,N,EOT: 0x4 received, secSize= 128...

147.578,SSURF,N,Received cmdfile 573 bytes
149.040,SSURF,N,Transmission succeeded...
149.128,HTI8,N,Updating parameter $SEABIRD_T_G to 0.0042812955
149.220,HTI8,N,Updating parameter $SEABIRD_T_H to 0.00061992655
149.313,HTI8,N,Updating parameter $SEABIRD_T_I to 2.2443779e-05
149.406,HTI8,N,Updating parameter $SEABIRD_T_J to 2.3337107e-06
149.499,HTI8,N,Updating parameter $SEABIRD_C_G to -9.9470167
149.588,HTI8,N,Updating parameter $SEABIRD_C_H to 1.1498449
149.681,SUSR,N,WARNING! $SEABIRD_C_I,-0.0001: Recommended range is between -0.0050 and -0.000
149.805,HTI8,N,Updating parameter $SEABIRD_C_I to -9.315474e-05
149.898,HTI8,N,Updating parameter $SEABIRD_C_J to 0.00010132478
149.990,HTI8,N,Updating parameter $PRESSURE_SLOPE to 0.000011485742
150.084,HTI8,N,Updating parameter $VBD_MIN to 435
150.158,HTI8,N,Updating parameter $VBD_MAX to 3963
```

Figure 7-39. File upload to Seaglider

20. During the test dives:
    a. Monitor the activity.

       Files should be successfully transmitted bi-directionally between Seaglider and the basestation. If a transfer fails during the test, let the test continue through the five dives. Perhaps the Iridium satellite was shaded at the time. However, after the dives are complete, investigate the failures and make sure that there is a full understanding of the mechanism. Repeat the simulated dives, if necessary.

    b. When Seaglider is starting its 5th dive, change the directive in the cmdfile on the basestation from **$GO** to **$QUIT**. Seaglider uploads the file at the next 'surfacing' and remains on the surface.

    c. Wand off Seaglider after it is parked on the 'surface' following the fifth dive and all files have been transferred to the basestation. Press Enter on the laptop several times. If information displays, Seaglider is not off. Wand off again. If nothing displays after you repeatedly press Enter, Seaglider is off. As a double check, leave Seaglider outside for 5-10 minutes and monitor the basestation or laptop for any Seaglider activity. If Seaglider calls in, it is not off and burning battery power! Wand it off again and monitor to make sure it is off.

21. Disconnect the communication cable from Seaglider and the laptop and reinstall the dummy plug on the Seaglider communication connector.

22. If it is easier to store or move Seaglider in its cradle without the antenna mast attached, detach it (leave the cables attached to aft end cap) (see "Pagers file" on page 181).

23. After the test dives:
    a. Review all of the files generated by Seaglider and the basestation during the simulated dives. See Chapter 9, "Files for Operations" on page 171 for an explanation of each file. Check the .log and .cap files for errors and warnings. Check the science sensor data in the .eng file. Check the comm.log files for communication exchanges between Seaglider and the basestation. If anything looks suspect, investigate and understand the cause and correct before continuing.

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b. Copy these files into a date-encoded subdirectory of the Seaglider home directory (/home/sgXXX/SimulatedDive_DDmonthYY).

   Type the following command to transfer the files (longhand method), and then press Enter.

   ```
   /usr/local/basestation/movedata.sh -mission_dir <source_dir> -t
      target_dir>
   ```

   If you are in Seaglider home directory and want to move it to a subdirectory of that home directory, type the following command (the shorthand method), and then press Enter:

   ```
   movedata.sh subdirectory_filename
   ```

   You can also use the UNIX `mv` command to move data from the home directory.

ARGOS tag

Prior to deployment user parameters must be programmed into the SPOT5 Argos tag to properly fit the application needs for a Seaglider mission. User parameters are programmed into the SPOT5 via a Windows-based program provided by Wildlife Computers called SPOT5Host. The SPOT5 is connected to a PC via the USB-Blue, available from Wildlife Computers only. SPOT5Host synchronizes communications with the POST5's on-board software. It sends and receives commands to the SPOT5. Parameters are downloaded from SPOT5 to the PC. SPOT5Host allows modification of those parameters. After the parameters are set, they can be uploaded to the SPOT5.

For directions on programming SPOT5 user parameters, see "Setting up and installing the Argos SPOT5 tag" on page 126.

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CHAPTER 8

Tuning Your Seaglider

Tuning your Seaglider

The pilot is responsible for tuning the glider during a deployment. After Seaglider has surfaced from its first dive and transmitted the data files to the basestation, review the .log file and the capture file, if it is sent (recommended at the beginning of a mission) and analyze the data. When reviewing the .log file, look at the time in the GPS line. Is it current? Is the GPS fix believable? Are the internal pressure and humidity values within range? Are there any retries or errors? Plot the data from the .eng and .log files using the MATLAB scripts provided on the CD shipped with Seaglider.

Look at the main plot (Figure 8-1). Interpretation of the plot is a major subject in training class.

- Does the dive velocity match the desired velocity?
- Is the buoyancy (VBD) set properly for water density at the prescribed depth?
- Is Seaglider pitched properly? If the pitch setting is incorrect, it affects the vertical velocity. If the VBD and the pitch are both set correctly, Seaglider has a symmetrical dive pattern.
- Is Seaglider flying straight? This is dependent upon the roll centers being properly set. Normally, adjustments to the Seaglider system's flight path are made in the order VBD and Pitch during the early, shallow dives, then, the roll is adjusted during the deeper dives when Seaglider has time to glide between motor movements. If any changes to the VBD, Pitch and roll centers are needed, the rule of thumb is to only adjust half the amount suggested by the plot regression for 'Implied.'

  Using this approach look at the first plot (an example is below) and compare when the VBD (thin black line) and the vertical speed (W) (royal blue line) cross zero.
- If they cross zero at the same time the VBD setting is good and should be left alone.
- If the VBD line crosses zero before the W line does, Seaglider is too heavy and the C_VBD A/D counts should be reduced.
- If W crosses zero before the VBD line crosses zero, Seaglider is too buoyant and the C_VBD A/D counts should be increased.

In the following example, the W line crosses zero before the VBD line, so Seaglider is too buoyant.

To figure out how much to increase the C_VBD by in the example below, determine the number of units that separates the W line from the VBD line where the W crosses zero. In the example it is approximately 4 units. Multiply that value by the number of cc's in parentheses next to VBD in the

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legend. In the example it is 10cc. So 4* 10cc = 40 cc. Now convert the 40cc to A/D counts using the conversion factor 4.0767 A/D counts/cc to get an A/D counts change of approximately 160.

Following the rule of thumb to only make half of the adjustment at a time, the C_VBD would be changed from the original A/D counts of 3276 + 80 = 3356 and the parameter value would be changed in the cmdfile to read **$C_VBD,3356**.

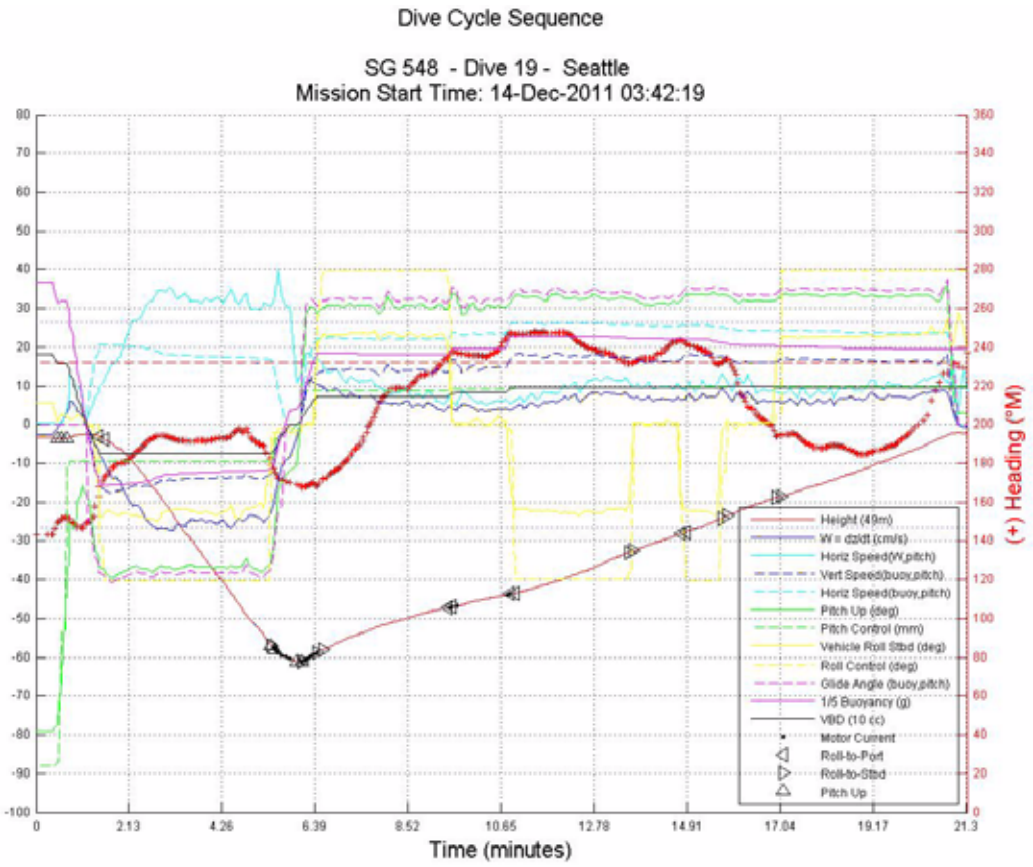


Figure 8-1. Main plot

- Look below at the pitch plot (Pitch Control versus Pitch (deg)) and the regression analysis located on the plot, showing what the present pitch center **$C_PITCH** is and what the recommended pitch center is (Figure 8-2).

  Following the rule of thumb for making changes to the parameter value: the present **$C_PITCH** value is 2829 and the Implied (desired) **$C_PITCH** is 2835 so the correction put into the cmdfile would be **$C_PITCH,2832**. This change in the **$C_PITCH** parameter value is very small and is actually in the 'noise.' Generally, if the difference in A/D counts between the actual and implied **$C_PITCH** values is less than 15-20 counts no adjustment is made. Additionally, at the bottom of the plot is the calculated pitch gain. The initial **$PITCH_GAIN** value should be adjusted by half

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of the difference between it and the calculated pitch gain (rounded to the nearest whole number) and loaded into Seaglider via the cmdfile transfer.

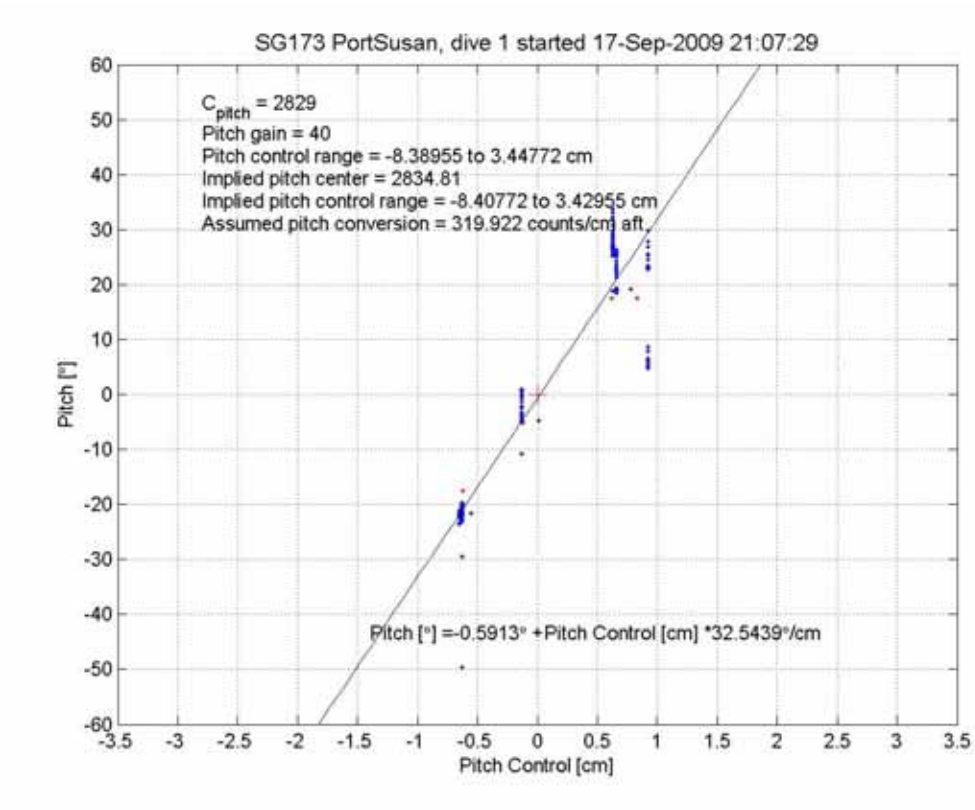

SG173 PortSusan, dive 1 started 17-Sep-2009 21:07:29
C pitch = 2829
Pitch gain = 40
Pitch control range = -8.38955 to 3.44772 cm
Implied pitch center = 2834.81
Implied pitch control range = -8.40772 to 3.42955 cm
Assumed pitch conversion = 319.922 counts/cm aft
Pitch [°] =-0.5913° +Pitch Control [cm] *32.5439°/cm
Pitch [°]
Pitch Control [cm]

Figure 8-2. Dive 1 pitch plot

- Inspect the science data plots and data files. Is the data believable?

  If there is a problem with the science data Seaglider may have to be recovered.

  If the science data looks good and the cmdfile has been updated with the latest **$C_VBD, $C_PITCH and $C_PITCH_GAIN,** it is time to start the second dive.
- Check that the new **$C_VBD**, **$C_PITCH**, and **$C_PITCH** parameters have been transferred to Seaglider and are correct. If they are, change the directive in the cmdfile from **$QUIT** to **$RESUME.** Leave the dive parameters the same as for the first dive. When Seaglider calls in again after **$T_RSLEEP** it picks up the new directive and begin the second dive.
- The pilot should communicate with the field team what is being done and the field team should let the pilot know when Seaglider leaves the surface on the second dive. The pilot can then change the directive in the cmdfile from **$RESUME** to **$QUIT** so that Seaglider remains on the surface after the second dive.
- When Seaglider surfaces after the second dive, the pilot should check the log file, plot the data, review the plots, especially the VBD and pitch plots, and make any needed adjustments to the **$C_VBD** and **$C_PITCH** A/D counts and **$PITCH_GAIN**. If the pilot feels comfortable with Seaglider, the field team can be dismissed. It is also the pilot's decision whether to have Seaglider do another shallow dive or whether the next dive should be a 100-200m dive. If the depth is

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increased remember to edit **$D_TGT**, **$T_DIVE,** and **$T_MISSION**. Remember to check what directive is in the cmdfile and change it, if necessary.

By the third or fourth dive, the value for **$SM_CC** set at the beginning should be revisited. Initially **$SM_CC** is set conservatively to make sure Seaglider gets back to the surface. However, the σ_T versus VBD (cc) plot shows what the **$SM_CC** setting currently is and what the setting could be changed to.

Figure 8-3 shows an example plot. The current setting is located in the upper left corner of the plot (CC_{SM}=700) and the statement $CC_{surf\ min}$ = 370 shows what the **$SM_CC** value could be changed to, to get the full antenna mast out of the water.

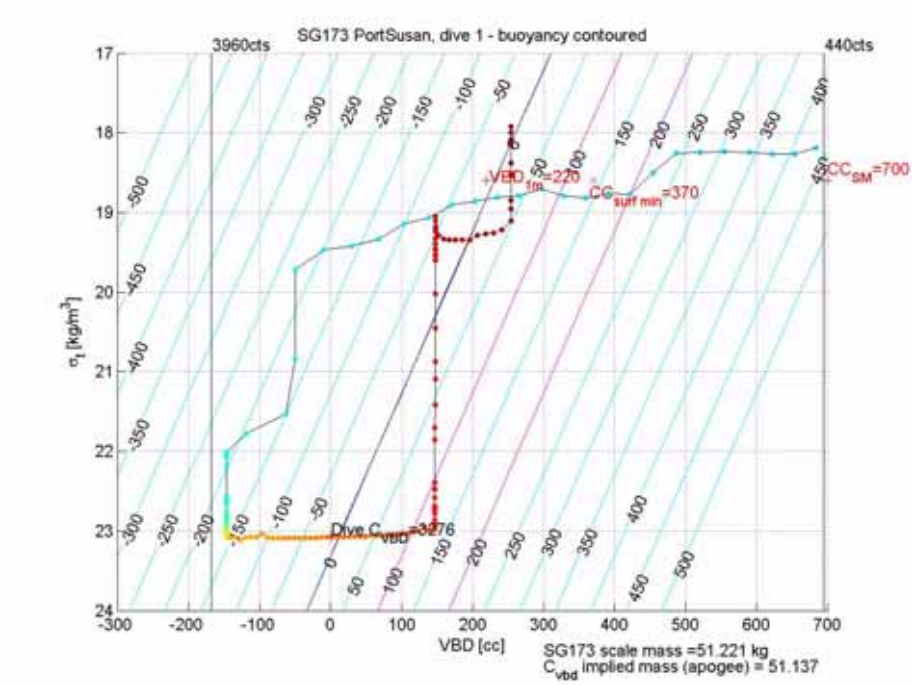


Figure 8-3. $SM_CC values

After several 100m or greater depth dives look at the roll plot (Roll Control (deg) versus Roll (deg)) and the roll regressions on the plot and make any necessary corrections. Remember the rule of thumb for making changes and only make half of the correction desired at a time.

Figure 8-4 shows an example of a roll plot. In the example, **$C_ROLL_CLIMB** is currently set at 2000 A/D counts. The implied (desired) **$C_ROLL_CLIMB** A/D counts is approximately 2350. Taking the difference between the two values and dividing by two the **$C_ROLL_CLIMB** value should be changed to 2175.

Follow the same procedure for determining the correction to the **$C_ROLL_DIVE** value.

As the trimming becomes less drastic, the need to park Seaglider on the surface after a dive with the **$QUIT** command, while changes to the parameter values are made and then to issue the **$RESUME** directive to continue diving, becomes less critical.

At this point, if Seaglider is diving, the directive should be changed from **$RESUME** to **$GO** and any changes made to a parameter are picked up at the next surfacing.

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Remember that with the **$GO** directive, if Seaglider encounters a problem and has to surface unexpectedly, it remains at the surface until the pilot replaces **$GO** with **$RESUME**. DO NOT leave **$RESUME** in your cmdfile longer than necessary. It may lead to the loss of your Seaglider.

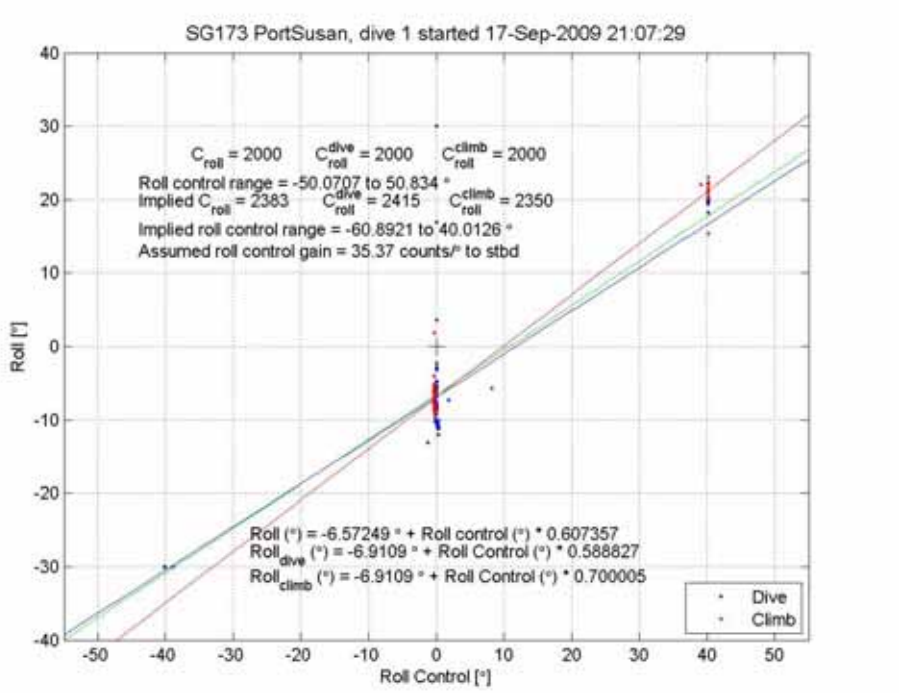

SG173 PortSusan, dive 1 started 17-Sep-2009 21:07:29
C_roll = 2000 C_roll^dive = 2000 C_roll^climb = 2000
Roll control range = -50.0707 to 50.834 °
Implied C_roll = 2383 C_roll^dive = 2415 C_roll^climb = 2350
Implied roll control range = -60.8921 to 40.0126 °
Assumed roll control gain = 35.37 counts/° to stbd
Roll (°) = -6.57249 ° + Roll control (°) * 0.607357
Roll_dive (°) = -6.9109 ° + Roll Control (°) * 0.588827
Roll_climb (°) = -6.9109 ° + Roll Control (°) * 0.700005
Dive
Climb
Roll [°]
Roll Control [°]

Figure 8-4. Roll center values

Continue to monitor the plots and the log files each time Seaglider surfaces until the trimming looks good and Seaglider is diving to the desired mission depth. As the pilot becomes comfortable with how Seaglider is flying, plot and file checks can be reduced, if desired, to several times a day.

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CHAPTER 9

Files for Operations

To be a successful pilot, gathering high quality data during the mission and bringing Seaglider home safely, you need to understand the intricacies of the files that must be generated to fly Seaglider as well as the contents of the files that are generated by Seaglider during the mission.

Files placed on the basestation by the pilot

To command and control Seaglider, the pilot interacts with four files on the basestation:

- Command file (cmdfile)
- Targets file (targets)
- Science file (science)
- PicoDOS Commands Batch File (pdoscmds.bat)

These files are sent to Seaglider during a surfacing. However, unless there are changes to the target, science, or pdoscmds.bat files, they do not have to be sent to Seaglider at each surfacing.

Only the cmdfile must be sent to Seaglider at each surfacing. After one of these files has been uploaded to Seaglider, the number of the dive is appended to the file name on the basestation. If Seaglider calls in to the basestation more than once while at the surface, the files are uploaded each time if they are present on the basestation and after each upload not only is the dive number appended as a .number, but the upload number is appended as a .number to the dive number.

The following example shows when the file is uploaded and how it is named:

1. A cmdfile is uploaded to Seaglider.
2. The basestation makes a copy of the cmdfile named cmdfile.1.
3. Seaglider is still at the surface, calls in again.
4. The cmdfile is uploaded to Seaglider.
5. The basestation makes a copy of the cmdfile named cmdfile1.1.
6. Seaglider is still at the surface, calls in again and the cmdfile is uploaded to Seaglider.
7. The basestation makes a copy of the cmdfile named cmdfile1.2.
8. Seaglider then dives.
9. At the next surfacing a cmdfile is uploaded to Seaglider.

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10. After the upload, the basestation makes a copy of the cmdfile named cmdfile.2.
The same process is used for the targets, science and pdoscmds.bat files. For more details on these files, see the corresponding sections.

A fifth file, the sg_calib_constants.m file is generated at the factory. It is not sent to Seaglider. Instead, it is used shore-side by MATLAB to process the .eng files and .log files and produce Seaglider data plots (“Calibration file”).

Command file

The cmdfile is sent to Seaglider at each surfacing. The cmdfile configuration comprises the following parts:

- A list of <parameter_name>,<new_value> pairs with no spaces between the parameter_name, comma, and new_value.
- The last line of the file is a directive (required) and can have no newline character after the directive.

The command file may contain only the directive. So, if no changes are needed in the cmdfile and Seaglider is to continue diving after the next surfacing, it can contain the only the directive **$GO**.

If no changes are needed in the cmdfile and Seaglider is to remain at the surface after the next surfacing, the command file can only contain the directive **$QUIT**.

If parameters are left in the cmdfile from dive to dive, they are sent each time Seaglider surfaces even though the value of the parameter has not changed between dives.

Figure 9-1 shows an example of a cmdfile with parameters and a directive.

```
$D_TGT,150
$T_DIVE,50
$T_MISSION,60
$SM_CC,680
$C_ROLL_DIVE,2388
$C_ROLL_CLIMB,2321
$USE_BATHY,-4
$ALTIM_SENSITIVITY,4
$QUIT
```

Figure 9-1. Example cmdfile

Targets file

Seaglider navigates using either heading or targets (waypoints). If heading is used, it is turned on in the cmdfile **($HEADING,**value in degrees) (see “$HEADING” on page 76).

If Seaglider is moving from location to location using targets (latitude and longitude) also known as waypoints, it is getting this information from the targets file.

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Figure 9-2 shows an example of a targets file, and Table 9-1 describes each column. For another example, see Appendix B, “Seaglider File Formats Manual” on page 201.

```
/ Sample North Carolina Coast targets
NCSPONE   lat=3357.4   lon=-7623.5   radius=200   goto=WPONE     timeout=1
WPONE     lat=3356.0   lon=-7625.2   radius=200   goto=WPTWO     timeout=1
WPTWO     lat=3353.9   lon=-7625.2   radius=200   goto=WPTHREE   timeout=1
WPTHREE   lat=3352.2   lon=-7621.4   radius=200   goto=WPFOUR    timeout=1
WPFOUR    lat=3356.6   lon=-7623.8   radius=200   goto=NCSPONE   timeout=1
```

Figure 9-2. Example targets file

Table 9-1. Description of columns in target file

Column	Description
1	Name of the target Seaglider is heading to
2	Latitude of the target Seaglider is heading to in degrees, minutes, decimal minutes
3	Longitude of the target Seaglider is heading to in degrees, minutes, decimal minutes
4	Distance in meters Seaglider can be from the target and still be considered having reached the target
5	Name of the next target to go to after it has reached the present target
6	After the timeout is exceeded the glider will proceed to the next waypoint as though it had just reached the current waypoint. The timeout if a floating point value and is specified in days.

The file in Figure 9-2 contains all of the fields necessary to direct Seaglider to targets. There are also three optional fields, which can be added as columns in the targets file.:

```
escape=WPONE      depth=100      finish=90
```

where:

- The escape target specifies what target to move to if Seaglider has been unable to navigate for a specified length of time (stuck under an object). The escape target must be a valid named target.
- The depth allows the pilot to define the target as a depth.
- The finish specifies a direction (degrees), and establishes a finish line through the target, perpendicular to the direction specified. The target is considered achieved when the difference between the bearing to the target and the finish direction is greater than 90 (or less than -90) degrees.

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Example 1. Finish direction of 90 specifies a north-south finish line drawn through the target; the target is achieved when Seaglider is east of the line.

Example 2. Finish direction of 180 specifies an east-west finish line; target is achieved when Seaglider is south of the line. A value of -1 or no specification of finish means that no finish line is tested.

For new missions, Seaglider heads to the first waypoint listed, in this case the one called NCSPONE. To change the waypoints file during a mission the pilot can upload a new targets file when Seaglider surfaces. However, use caution when doing this.

- If an active target name from the old targets file is in the new targets file, Seaglider retains that active target.
- If an active target is not in the new targets file, then Seaglider goes to the first target in the list.
- If there is no valid targets file on Seaglider, it uses the default target (**$TGT_AUTO_DEFAULT**, **$TGT_DEFAULT_LAT**, **$TGT_DEFAULT_LON**) specified in the cmdfile.

  Though specification of a default target is optional, it is highly recommended that you enter the latitude and longitude coordinates of a location where you can recover Seaglider in the event that it loses its targets file.

ALI sensors

ALI sensors are controlled by multiple parameters (Table 9-2). The **$xx** is the prefix for a given sensor that is defined by the command prefix in the .cnf file. The prefix for the GPCTD is PC; the prefix for ADCP is CP; the prefix for Echosounder is ES. For more details, see Table 5-3 on page 49.

Table 9-2. Parameters for ALI sensors

Sensor parameter	Description
$xx_RECORDABOVE	Depth (in meters) above which the logger is on. A value of 0 turns the sensor off. Minimum Value: 0 Maximum Value: 1000
$xx_PROFILE	Which half of the profile to run the logger 0=none, 1=dive, 2=climb, 3=both
$xx_XMITPROFILE	Parameters are specfic for each sensor. For details about the parameters for each sensor, see $PC_XMITPROFILE, $ES_XMITPROFILE, and $CP_XMITPROFILE in Table 5-4.
$xx_UPLOADMAX	The maximum file size (in bytes) limit on uploaded files, if file size limitation is supported by the sensor. Currently, no supported sensors support file size limitation, so this parameter is unused. Minimum Value: 0, no data uploaded
$xx_STARTS	Running count of the number of sensor restarts that occur during a mission.

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Table 9-2. Parameters for ALI sensors (Continued)

Sensor parameter	Description
$xx_RECORDCONTINUOUS	Specifies whether to stop sensor sampling during apogee and start a new cast on ascent (0) or to continue recording the first cast of data through apogee leaving one file per dive (1). Minimum Value: 0 Maximum Value: 1 Recommended Value for GPCTD: 0 Recommended Value for ES: 1 Recommended Value for AD2CP: 1
$xx_RECORDAPOGEE	Specifies whether to sample during apogee (1) or not (0). This parameter is only used if $xx_RECORDCONTINUOUS is 0. Minimum Value: 0 Maximum Value: 1 Recommended Value: 1

Additional parameters can be defined using param-x=, param-y=and param-z=. For example, specifying param-x=RATE and specifying $xx_RATE,1.2 in the cmdfile will cause the interpreter to expand %x in a command string to the value 1.2.

Lines in script files (x, y, and z) are fully interpreted. The script mechanism is intended to allow complex, multi-command interactions or to provide a pilot control of a device during a mission. For example, a start command might become:

start=%X
script-x=device.bat

where the contents of device.bat are:

%r%pvalue1=17.0%r
%pvalue2=0.05%r
%pstart%r

The pilot could change the values of the parameters value1 and value2 by creating a new file device.bat on the basestation. That file will be transferred to the glider CF card during a call and the logdev driver will send the commands changing those values the next time it issues a start command.

Science file

The science file controls how often any OSI science sensors and the G&C sensors are sampled. The sample rate for each science sensor is independent of the other science sensors. The sampling protocol is specified by depth bins and each bin can have a different sampling protocol. The practical lower limit on sampling is 4 seconds and is closer to 7 seconds with many sensors installed.

If only the conductivity and temperature sensors are sampled, it can be possible to sample every 4 seconds, but with the oxygen and BBFL2 or BB2FL optical sensors also being sampled, 5 seconds is the lower limit. The science file also provides the ability to turn off sensors, or only energize them every n^{th} sample, in a given depth range (or ranges).

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Figure 9-3 shows an example science file, and Table 9-3 describes the columns. For another example, see Appendix B, “Seaglider File Formats Manual” on page 201.

```
// Science for North Carolina Coast
/edit for Individual Seaglider w/: CT, SBE-43F oxy, WET Labs BB2FL-VMT
/depth          time            sample          gcint
50              5               111             30
200             5               121             60
1000            5               103             120
```

Figure 9-3. Example science file

Table 9-3. Description of columns in science file

Column	Description
1	The deepest depth (in meters) for this depth bin. Every depth bin is defined by a row in the science file.
2	Base sampling interval in seconds
3	Multipliers for each of the installed sensors, applied to the base sampling interval. The order is dependent on the number of the slot each sensor is installed in.
4	Guidance and Control (G&C) sampling interval

Sampling Rate = Sample time x respective sensor sample interval

where:

- Sample time = value in column 2
- CT = 1st digit of the value in column 3
- SBE-43 = 2nd digit of value in column 3
- WET Labs = 3rd digit of value in column 3

The science sampling for this file works as follows, looking at the sampling protocol rows:

- First row of sampling protocol:
  - Sampling in depths from 0-50m.
  - Each of the sensors is sampled once every 5 seconds.

    This value is calculated by multiplying the 5 in column 2 by the first digit (1) in column 3 for CT, by the second digit (1) in column 3 for SBE-43F and by the third digit (1) in column 3 for the WET Labs sensor.
  - G&C sampling between 0 and 50m occurs once every 30 seconds.

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- Second row of sampling protocol:
  - Sampling depths between 50 and 200m.
  - The CT and WET Labs sensors are sampled once every 5 seconds.

    This value is calculated by multiplying the 5 in column 2 by the first digit in column three for the CT sensor and multiply the 5 in column 2 by the third digit in column three for the WET Labs sensor.
  - The SBE-43F oxygen sensor is sampled once every 10 seconds.

    This value is calculated by multiplying the 5 in column 2 by the second digit in column 3.
  - The G&C sampling occurs once every 60 seconds.
- Third row of sampling protocol
  - Sampling depths between 200 and 1000 m.
  - The CT sensor is sampled once every 5 seconds.

    This value is calculated by multiplying the 5 in column 2 by the first digit in column 3.
  - The SBE-43F oxygen sensor is not sampled.

    This value is calculated by multiplying the 5 in column 2 by the second digit (0) in column 3.
  - The WET Labs sensor is sampled once every 15 seconds.

    This value is calculated by multiplying the 5 in column 2 by the third digit (3) in column 3.
  - The G&C sampling between 200 and 1000 m occurs once every 120 seconds.

NOTE: The bound on the depth interval is dependent on pressure sensor resolution. Choices made in the science sampling have an impact on the energy use of Seaglider. More samples and shorter G&C intervals use more processor and sensor power than do fewer samples and longer G&C intervals.

PicoDOS commands batch file

This file contains picoDOS direct actions, such as resending dive files from Seaglider to the basestation and changing targets out of sequence. Examples of pdoscmds.bat files are below.

If Seaglider is flying toward the target, called WPONE in the example on page 241 under the targets description and the pilot wants to redirect it to head toward WPTHREE at the next surfacing, the pdoscmds.bat file looks like:

target WPTHREE

If the pilot wants Seaglider to resend all files from dive 2 to the basestation, the pdoscmds.bat looks like:

resend_dive 2

(See resend_dive on page 241.)

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Multiple commands can be sent in the same pdoscmds.bat file. For example, if the pilot wants dive 2 resent and wants to change the waypoint Seaglider is heading to, to WPTHREE the pdoscmds.bat file looks like:

target WPTHREE

resend_dive 2

Order of the commands in the pdoscmds.bat file is not critical. For a full list of commands that can be included in the pdoscmds.bat file, see Appendix C, “Extended PicoDOS® Reference Manual, v66.07” on page 233.

Factory-generated file

The initial sg_calib_constants.m file is generated at the factory.

Calibration file

The sg_calib_constants.m file contains calibration information for that particular Seaglider and the sensors installed on it and is used for basestation calculations and MATLAB plots. There should be no need for edits to this file between factory refurbishments. If edits are deemed necessary, do so with caution.

For an example of a sg_calib_constants.m file, see Appendix B, “Seaglider File Formats Manual” on page 201. The values in the sg_calib_constants file for your Seaglider differ from the values listed.

Seaglider generated files

Seaglider generates the following files:

- Capture (.cap)
- Log (.log)

Capture files

The capture (.cap) file contains information about all of the actions Seaglider took during the previous dive.

Capture files are a great source of information on the performance of Seaglider, especially in error analysis and debugging. However, they can become quite large (multi-hour dives) and are not always sent to the basestation during a surfacing. It is recommended that for the first few dives of the mission, while Seaglider is being tuned for flight efficiency, that the .cap files be sent to the basestation. The parameter **$CAPUPLOAD** controls this feature (Chapter 5, “Piloting Parameters” on page 47).

The format of the capture file is not as hard and fast as other file formats, but it usually conforms to the following format: time, service, output level, text.

For an example of a .cap file, see Appendix B, “Seaglider File Formats Manual” on page 201.

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Log files

The .log file serves as a summary record of what happened during the dive. One .log file is made for each dive.

The first portion of the data is a list of the Seaglider parameters and their values for that dive. For an explanation of each parameter, see Chapter 5, “Piloting Parameters” on page 47.

The second section, beginning with the entry **$GPS1**, contains information concerning the pre-dive period at the surface, what target Seaglider is heading to during the next dive, Kalman filter information, and D_GRID information if bathymetry maps are being used.

The **$GC** labeled lines describe motor actions (pitch, roll, or VBD), one line per motor move. The information listed after the **$GC** lines is data collected at the end of the dive (for example, surface maneuver data, final temperature reading). Some of this data is from the previous surfacing (before the start of the current dive).

The **$SM_CC** labeled lines contain information on the surface maneuver.

The remaining lines of the log contain information on internal humidity, pressure and temperature, battery power available and amp hours used, ending with a summary of errors encountered during the dive and the GPS position immediately after surfacing.

Not all Seagliders report all of the lines that appear in the example, because the devices installed vary among Seagliders.

Files generated by the GPCTD

ALI devices will generate unique output files which can be recognized by the prefix for that sensor, as defined in the .cnf file. For example, the GPCTD generates the following four files per every dive, which use the prefix “pc”:

- pc a.eng
- pc b.eng

The files labeled with an “a” represent the descent phase while the “b” represents the ascent phase.

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Basestation-generated files

The basestation generates the following files, using data provided by Seaglider:

- Baselog (baselogXXXXXXYYYYYY.com)
- Communications (comm.log)
- Engineering (.eng)
- Pagers (.pagers)
- Processed files cache (processed_files.cache)
- Private (.pvt)
- URLs (.urls)

iRobot basestation software has the ability to create the following files, however iRobot does not support these files.

File extension	Variable to add to .logout GLIDER_OPTIONS parameter to produce these files
.asc	make_dive_intermediate_files
.dat	make_dive_intermediate_files
.nc	make_dive_netCDF
.gz	make_dive_netCDF
mission_ts_nc	make_mission_timeseries
mission_pro.nc	make_mission_profile
pro	make_dive_pro
bpo	make_dive_bpo
dn_kkyy	make_dive_kkyy
up_kkyy	make_dive_kkyy

Baselog file

The baselog file is produced by the basestation, and logs the output from the scripts that perform the conversion and notification functions of the basestation. It is written during each invocation to the Seaglider home directory on the basestation.

This file is the first place to look when debugging problems with the data conversion. If the basestation cannot process a file, it sends an alert to any contact listed in the .pagers file who requested alerts. For more information, see “Pagers file” on page 181.

The naming convention for the baselogXXXXXXYYYYYY.com file is:

- XXXXXX — the date in ddmmyy format
- YYYYYY — the time in hhmmss in the timezone on the basestation

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Communications file

The communications (comm.log) file is resident in the Seaglider home directory on the basestation. The plain text file is appended to during each communication session with Seaglider. So, not only is it a complete record of the Seaglider system's communications over an entire deployment, it can become quite large.

To monitor the end of the file for any new additions, type **tail –f comm.log** on the command line in the Seaglider home directory.

For an example of a comm.log file, see Appendix B, "Seaglider File Formats Manual" on page 201.

Engineering files

The .eng, or engineering files are created on the basestation. For a description of the column titles, see Appendix B, "Seaglider File Formats Manual" on page 201.

Pagers file

The .pagers file controls the automatic email, pager, and text message notification system. The file allows any of four types of messages (gps, alerts, recov, comp) to be sent to any valid email address or phone number. This service is run by the data conversion script, which is invoked by a Seaglider logout or disconnection.

Lines beginning with a # are comment lines and are ignored in processing.

The gps message is sent after every dive and is the most recent GPS position. The alerts message is sent when the basestation has a problem converting a file or files.

The alerts message indicates that a file may be corrupt and have to be resent by Seaglider to the basestation using the pdoscmds.bat file. For details, see "PicoDOS commands batch file" on page 177.

The recov message is sent when Seaglider goes into recovery mode. This message includes the most recent GPS position and the recovery mode.

The comp message is sent when processing of the lastest files received from Seaglider is completed by the basestation.

For an example .pagers file, see Appendix B, "Seaglider File Formats Manual" on page 201.

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Processed files cache file

The processed files cache (processed_files.cache) contains the list of files that have been processed by the basestation and the time of processing. To force a file to be re-processed, delete the corresponding file from this file. Comment lines are preceded by a #.

Mailers

The .mailers file is used by the basestation to e-mail generated files. Each line of this file contains an e-mail address followed by a comma-separated list of options. The grammar for this line is specified as

smtp_mail_address[,body|msgperfile|kkyy_subject|gzip] [,[eng| log| pro| bpo| asc| cap| comm| dn_kkyy| up_kkyy| nc| mission_ts| mission_pro]+] | ,all

These options are as follows:

- body - send the files in the mbody of the message and not as attachments, incompatible with the gzip, nc, mission_ts and mission_pro options
- msgperfile - Only send one message per file
- kkyy_subject - Use Navy specified XBTDATA as the subject line instead of informative subject
- gzip - Compress attachments using GZIP
- eng - Send .eng files
- log - Send .log files
- pro - Send .pro files
- bpo - Send .bpo files
- asc - Send .asc files
- cap - Send .cap files
- comm - Send comm.log files
- dn_kkyy - Send downcast kkyy files
- up_kkyy - Send upcast kkyy files
- nc - Send compressed NetCDF files
- mission_ts - Send compressed mission_ts files
- mission_pro - transmit compressed mission profile data
- all - send all files listed above

Only files that have been generated will be transmitted. For instance if NetCDF or Dive profile data has not been configured to be generated there will be no files to send even if the .nc and .pro options are chosen.

Example

typicaluser@billybob.com,msgperfile,body,eng,cap,log

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Files stored on Seaglider

The following files are stored on Seaglider.

Bathymetry map files

Map files provide Seaglider with geographic environmental information, specifically bathymetry about a given region of the ocean.

Seaglider can carry up to 999 bathymetry maps (the files are named bathymap.nnn, where .nnn is the map number), but in practice far fewer are typically on board. These maps are not required for Seagliders to fly, but provide a low energy means to determine apogee depth.

Note that the values in the bathymap files represent the depth at which Seaglider will start its apogee maneuver, NOT the actual bottom depth.

For more information on bathymetry maps, see Chapter 6, “Predeployment Tasks” on page 107.

Battery file

The battery file is used by Seaglider to keep track of power consumption throughout the time Seaglider is using the battery pack. This file is NOT intended to be edited by the user.

Capvec file

The Capvec file is parsed by Seaglider and updates one or more elements of the Capture Vector. Normally, this file is not used except for Seaglider provisioning. For details on updating the Capture Vector, see the capvec and parse_capvecfile commands in Appendix C, “Extended PicoDOS® Reference Manual, v66.07” on page 233.

The capvec file format is line oriented. Lines can be comment lines, in which case the first character must be a /. All other lines are updates to the Capture Vector (see the capvec command in the Appendix C, “Extended PicoDOS® Reference Manual, v66.07” on page 233).

Compass calibration file

The compass calibration file is generated when the compass is calibrated inside the assembled Seaglider at the factory. The calibration corrects for the effects of the metal on the compass readings. This file is NOT intended to be edited by the user.

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CHAPTER 10

Recovery and Disassembly

Recovery loop

In recovery, Seaglider enters a loop of obtaining a GPS fix and communicating with the basestation **$T_RSLEEP** minutes. In practice, there are about two minutes of overhead in this process, so that the actual time between phone calls is closer to **$T_RSLEEP** + 2 minutes. This recovery loop can be exited by sending a **$RESUME** directive to Seaglider in the cmdfile. Seaglider then continues diving.

NOTE: The following recovery procedures were developed by the University of Washington and adopted by iRobot as a method for recovering Seaglider from a small vessel. Seaglider missions and/or weather conditions can dictate a modified or even completely different method of recovery.

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Recovery phase

The recovery phase is entered either by the **$QUIT** command issued by the pilot via the cmdfile (to keep Seaglider at the surface) or by an error condition detected by Seaglider operating software. In recovery phase, Seaglider stays on the surface and acquires a series of GPS fixes which are sent to the basestation so that Seaglider can be recovered.

To begin recovery, the field team must in the vicinity of the anticipated surfacing location of Seaglider, with all support equipment, receiving the most recent GPS position of Seaglider via text message or voice contact with the pilot.

Field team

When the field team arrives in the recovery area, they should instruct the pilot to give Seaglider the **$QUIT** command so Seaglider does not dive again and stays on the surface.

Pilot

Give Seaglider the **$QUIT** command via the cmdfile.

Field team

1. Transit to the last set of GPS coordinates.
2. Search for Seaglider by looking for the antenna sticking out of the water.

   Binoculars may be helpful. Use the acoustic recovery system to ping Seaglider if visual conditions are poor. Follow the instructions in Chapter 6, “Predeployment Tasks” on page 107 to use the transducer.
3. Once a visual of Seaglider has been made:
   a. Transit to Seaglider.
   b. Make sure one of the handles of the cradle is tied off to the boat.
   c. Grab the antenna mast as close to the rear of the aft fairing as possible.
   d. Put the cradle in the water alongside Seaglider.
   e. Maneuver the cradle between the boat and Seaglider, and hook the rudder of the Seaglider on the top edge of the cradle.
   f. Pull Seaglider up.
   g. Hold on to both Seaglider and the cradle and pull both up out of the water just far enough so that the water can drain out of the nose of Seaglider.
   h. When Seaglider has finished draining, pull Seaglider and the cradle the rest of the way out of the water. Put the nose of the Seaglider into the cradle if it is not already inside the cradle.
   i. Connect the safety straps on the cradle around Seaglider.
   j. In a two-person lift, put the glide/cradle in a safe place on the deck of the boat.
   k. Secure Seaglider to the boat.
   l. Wand Seaglider off.
   m. Since the field laptop is not connected to Seaglider, have the pilot continue to monitor Seaglider for more phone calls to the basestation. If Seaglider is calling the basestation, it is not powered down and needs to be wanded off again.
4. Replace sensor dust caps and covers.

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5. Disassemble Seaglider – rudder, antenna and wings, in that order following the directions below. If sea conditions are poor, disassembly may be better accomplished back on shore.
   a. Rudder
      i Slide Seaglider backward until the rectangular slot on the aft end fairing is clear of the cradle end (see Figure 3-6 on page 18).
      ii Remove the screws holding the rudder in place.
      iii Remove the rudder.
      iv Set aside the rudder for packing and put the screws back in the spare hardware kit.
   b. Antenna
      i Slide the antenna mast out of the aft end of the fairing. Ease the cables out while doing this but do not disconnect them.
      ii Fold the antenna around so that it can be secured in the cradle.
   c. Wings
      i Working on one wing at a time, remove the upper screws holding the wing in place then rotate Seaglider slightly and remove the lower screws. Repeat for the other wing.
      ii Set the wings aside for packing and put the screws back in the spare parts kit.

1. Wash Seaglider (see Chapter 12, “1KA Seaglider Refurbishment” on page 195).
2. Pack Seaglider in its shipping crate (see Figure 2-1 on page 5).
3. Wash the launch and recovery cradle.
4. Disassemble the launch and recovery cradle.
   a. Remove the wing nuts and eye bolts from the small holes in the end plates with carrying handles. Put the hardware in the plastic spares kit.
   b. Detach the two top rails from the end plates with carrying handles by removing the large bolts using the ¾" wrench. Put the hardware in the plastic spares kit.
   c. Slide the straps off of the upper rails.
   d. Slide the yellow mesh from the upper rails and roll up.
   e. Detach the two lower rails from the end plates with carrying handles by removing the large bolts using the ¾"wrench. Put the hardware in the plastic spares kit.
   f. Pack the launch and recovery cradle parts in the shipping crate (see Figure 2-1 on page 5).

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CHAPTER 11

Operator Level Maintenance

Cleaning Seaglider

Cleaning Seaglider is not a scheduled task, but is done on an as-required basis, such as after a mission. After recovery from a salt water mission, Seaglider should be rinsed to prevent salt buildup.

Equipment Required

- Low-pressure water hose
- Clean cloth
- Compressed air (not to exceed 25 psi)

Consumables

- Deionized water
- Isopropyl alcohol
- 3M Silicone Spray

Parts

- None

1. Make sure the vehicle is powered down.
2. Remove the dust caps from the science sensors.
3. Place the Seaglider/cradle combination so that nose of the Seaglider is downward.
4. For cleaning of the CTD sensor, Sea Bird recommends flushing the conductivity cell with a dilute bleach solution to eliminate growth of bio-organisms, and eliminating the use of acid in most cases.
5. Remove the rudder and pull out the antenna shoe.
6. Wash down the exterior of the Seaglider using fresh water from the low-pressure water hose. Allow the water to flow through the conductivity and temperature sensor.
7. Rinse off the pressure hull (pupa) and inside of the glider by squirting water in the hole that the antenna shoe fits into, in the aft fairing.



CAUTION:
DO NOT use a power washer near the sensors.

8. Flush the conductivity and temperature sensor with deionized water.

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9. If your Seaglider is configured with additional sensors, be sure to rinse thoroughly with deionized water (Figure 11-4).

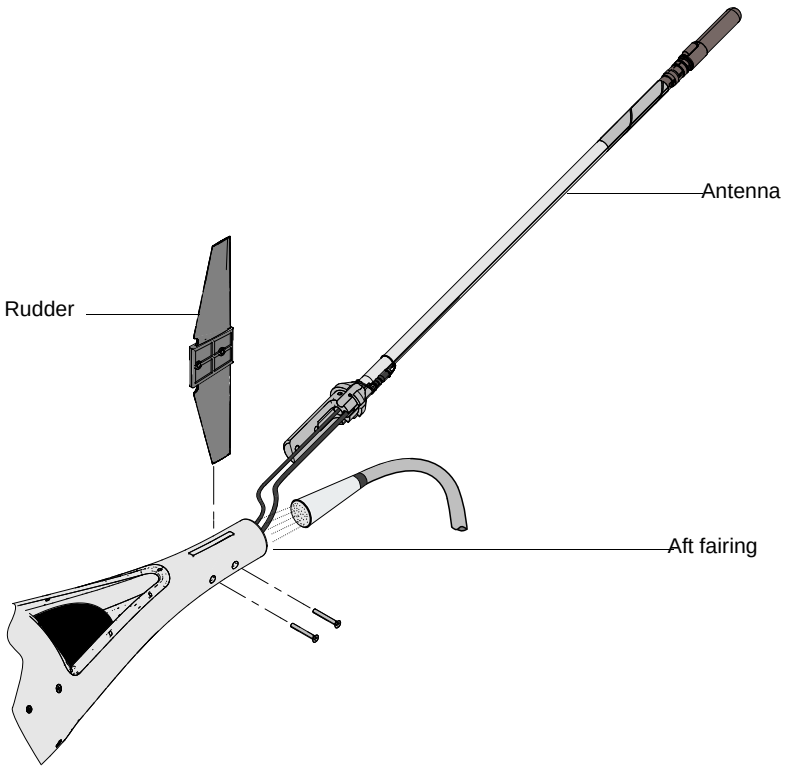


Figure 11-4. Postdeployment Seaglider cleaning

10. Flush the CTD sensor with deionized water.

    The conductivity cell should be left moist but not filled with water. Should the water freeze inside the cell the glass tubing could crack.

11. Remove the hatch covers.
12. Clean the sensor cable IE55 connectors and bulkhead connectors with soap and water and/or alcohol.
13. Use low-pressure compressed air to dry the connectors.

CAUTION:
Use only 3M Silicone Spray lubricant. The use of other lubricants, such as WD-40 or CorrosionX, will result in damage to the connector and subsequent failure of the sensor.

14. Lightly lubricate sensor connector mating surfaces with 3M Silicone Spray. Do not use silicone grease, as it may attract contaminates and foul the connector.
15. Use low-pressure compressed air to remove excess lubricant from the connector.
16. Replace the dust caps on all of the science sensors.

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Deep cleaning Seaglider

If there is more than one week between missions, if Seaglider has been deployed for multiple months or if there are signs of biofouling on the fairing, you must deep clean Seaglider.

1. Remove the wings, rudder, fore and aft fairings, and the antenna.
2. Reconnect the antenna to the pressure hull.
3. Using a fresh water tank, soak all pieces overnight (12+ hours).
4. Dry with a soft cloth.
5. Put Seaglider back in shipping case, if appropriate.

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Installing and configuring the AD2CP sensor

Equipment Required

AD2CP sensor
AD2CP to Seaglider data/power cable
Computer terminal with TeraTerm installed

1. Install the AD2CP to Seaglider cable from port R of the AD2CP to port F on the aft end cap of the Seaglider.
2. Power on the Seaglider.

   The console port displays the output from the main board.
3. Press Enter when the "otherwise will go to recovery" message is displayed.
4. Press Enter when prompted for the date and time.
5. Enter `Y` when the “Are you running on external (bench) power? [N]” message is displayed.

   The “Note tracking power consumption” message is displayed, followed by the list of the Main menu options.
6. From the Main menu, type `param` or **1**, and press Enter.

   The Edit parameters menu is displayed.
7. From the Edit Parameters menu, type `config` or **12**, and press Enter.

   The Edit Hardware Configuration Parameters menu is displayed.
8. From the Edit Hardware Configuration Parameters menu, type `logdev` or **11**, and press Enter.

   A list of the Current user logger files, and the User logger number (0-1,CR) prompt are displayed.
9. At the prompt, type the first number in the list where `[empty]` is displayed.

   The `.cnf file for new logger` prompt is displayed
10. Type `NCP.cnf` at the prompt, and press Enter.

    The Edit Hardware Configuration Parameters menu is displayed.
11. Press Enter.

    The `Re-initialize hardware configuration [N]` prompt is displayed.
12. Type `Y`, and then press Enter.

    Software initialization begins, and the Edit Parameters menu is displayed.
13. From the Edit Parameters menu, type `config` or **12**, and press Enter.

    The Edit Hardware Configuration Parameters menu is displayed.
14. From the Edit Hardware Configuration Parameters menu, type `show` or **1,** and press Enter.

    Several lines are displayed that show the available device slots. Then the Edit Hardware Configuration Parameters menus is displayed.
15. From the Edit hardware configuration parameters, type `logger` or **9,** and press Enter.

    The `Configure device in slot (1-4,CR)` prompt is displayed.

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16. Select one of the slots that begins with "Logger Sensor in logger slot" and indicates a sensor "is not installed."

    A list of attached logger sensors is displayed.

17. Type the item number corresponding to the line that lists **NCP**.

    A list of port numbers, 0 through 8, is displayed

18. Select either port **6** or port **7**, whichever port does not already have a device assigned to it.

    A few lines are displayed. One of them contains the phrase, "assigned NCP to logger sensor slot." Then the Edit Hardware Configuration Parameters menus is displayed.

19. Press Enter.

    The `Re-initialize hardware configuration [N]` prompt is displayed.

20. Type `Y,` and then press Enter**.**

    Software initialization begins, and the Edit Parameters menu is displayed.

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Verifying AD2CP sensor communications

1. Power on the Seaglider vehicle. If the Seaglider is already powered on, ensure that you are at the Main menu.
2. From the Main menu, type `hw` or **2**, and press Enter.

   The Hardware menu is displayed.
3. From the Hardware menu, type `loggers` or **12**, and press Enter.

   The Loggers menu is displayed.
4. From Loggers menu, select the item which corresponds to the NCP.

   The Logger Device Test menu is displayed.
5. From Logger Device Test menu, type `action` or **8**, and then press Enter.

   The following line is displayed:

   `Action? [2]`
6. Press Enter.

   A line that contains "`HNCP,N,sampling started`" is displayed. Then the Logger Device Test menu is displayed.
7. Wait 2 minutes for the sensor to collect data.
8. From the Logger Device Test menu, type `action` or **8**, and the press Enter.

   The following line is displayed:

   `Action? [2]`
9. Type **4**, and then press Enter.

   The following line contains `383.394,HNCP,N,sampling stopped`. Then the Logger Device Test menu is displayed.
10. From logger device test menu, type `action` or **8**, and then press Enter.

    The following line is displayed: `Action? [2]`.
11. Type **9**, and then press Enter.

    The following line contains "HNCP,N,Received ### bytes" and the number of bytes should be greater than 50:

    ```
    397.459,HNCP,N,downloading file cp3000au.x
    405.802,HNCP,C,Received 212 bytes
    Compressing cp3000au.x to cp3000az.x...
    408.157,HNCP,N,downloading file cp3000bu.a
    416.505,HNCP,C,Received 212 bytes
    Compressing cp3000bu.a to cp3000bz.a...
    ```

    If the number of received bytes is greater than 50, validation is complete.

    If the number of received bytes is 50 or less, contact iRobot Maritime Customer Support for guidance.

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CHAPTER 12

1KA Seaglider Refurbishment

iRobot refurbishment

Follow these steps to return your iRobot maritime product for refurbishment, calibration, or other service. Providing the following information, lets iRobot serve you better and prevents delay in the return of the product and/or instruments.

1. Request a quote/service request for refurbishment, calibration, or repair from iRobot through your sales contact, or send e-mail directly to maritimesupport@irobot.com.

   You will receive a Service Request form to fill out.
2. Submit the completed Service Request form to iRobot, following the instructions on the Service Request form.
3. After you receive a quote/service request, review it for accuracy and approve the quote in writing to maritimesupport@irobot.com.
4. Provide a purchase order or other approved method of payment reflecting amount of quote/estimate provided.
5. An iRobot representative will send you a Service Request (SR) number, including shipping instructions. Do not ship the items until you have approved the quote/estimate from iRobot contracts department and have issued a purchase order.
6. Send an e-mail with additional questions to maritimesupport@irobot.com.

What you need to provide

On the Service Request form, you will need to provide owner, shipping, and billing information.

Follow the instructions on the form for details about the technical information that you need to provide to maritimesupport@irobot.com prior to shipment of the unit for service. For example, you'll need to provide the following information:

- Unit serial number
- Self-test and simulated dive files
- Latest version of the Seaglider trim sheet
- List of parameters that have changed from the factory default values
- List desired services, spares, and/or diagnostics for your Seaglider product
- List of sensors and serial #'s to be recalibrated (if ordering OEM sensor recalibration service)

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APPENDIX A

System Specifications

Table A-1. 1KA Seaglider specifications

Feature	Specification
Body Size	1.8-2.0 meters long (configuration dependent), 30 cm max. diameter
Wing Span	1 m
Antenna mast length	Between .43 m and 1 m (configuration dependent)
Weight	52 kg (dry)
Batteries	Lithium Sulfuryl Chloride Primary Batteries, 24V and 10V packs, 17 MJ
Battery Endurance (fully charged batteries)	• Multiple months (mission dependent)
Computer Software	• Complete data transmitted after every dive • Web-based information interface • Control and system commands can be transmitted before each dive
RF Data Telemetry	Iridium satellite data telemetry

Table A-2. 1KA Seaglider performance specifications

Feature	Specification
Operating Depth Range	50 to 1,000 m (configuration dependent)
Maximum Travel Range/Duration	4,600 km (650 dives to 1-km depth)
Typical Speed	25 cm/s (1/2 knot)
Glide Angle	16° to 45° (1:3.5 to 1:1 slope)

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Table A-3. Standard sensors

Paine Pressure Sensor

Table A-4. Optional sensors

Sea-Bird 43F dissolved oxygen sensor (pumped)
Sea-Bird dissolved oxygen sensor (unpumped)
Sea-Bird CT Sail
Aanderaa dissolved oxygen
WET Labs ECO Pucks™
Photosynthetically Active Radiation (PAR) sensor
Sea-Bird Glider Payload Conductivity Temperature Density (GPCTD) sensor
Acoustic Doppler Current Profiler (Nortek AD2CP-Glider)
Imagenex 853ES Echosounder

Table A-5. Mechanical features

Isopycnal pressure hull
No external moving parts
Low drag, flooded fairing

Table A-6. Electrical features

Ultra-lower power micro-processor
High-capacity compact-FLASH memory
4 open serial channels for sensors
1 open frequency channel for sensors

Table A-7. Guidance and Control (G&C)

Dead reckoning between surface GPS fixes using 3-axis digital compass
Kalman filter prediction for mean and oscillatory currents
Acoustic altimetry systems for near-bottom dives
Bathymetry map system for low-energy dives

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Table A-8. Operational modes

Mode	Description
Transect survey	Profiles using a sequence of waypoints
Virtual mooring	Continuously profiles at a single location
Surface drift	Stays on the surface with the antenna up for GPS and data telemetry
Bottom loiter	Loiters at designated depth for a specified amount of time before surfacing
Subsurface porpoise	Profiles a specified depth range without surfacing

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APPENDIX B

Seaglider File Formats Manual

SCHOOL OF OCEANOGRAPHY

and

APPLIED PHYSICS LABORATORY

UNIVERSITY OF WASHINGTON

Version 66.07 December 2009

Chapter 1

Conventions and introduction

1.1 Conventions

Example files are given in bold Courier font. Direct annotations of files are given in smaller font. Parameters are in UPPER CASE BOLD font, and have a preceding $. File names that are used in Seaglider command, control, or operations are given in lowercase bold font. Documents and sections of documents are italicized.

123 is used throughout this document as a placeholder for Seaglider serial number, and 55 is used as a placeholder for dive number. Many file names include a three digit Seaglider serial number, followed by a four digit dive number, both with preceding zeros (e.g., p1230055.log). Numerals after the dot in a filename are represented by 0s and, when additional numerals are needed, 9s. Because they represent various meanings, numerals after the dot are always annotated the first time the file name appears, and in the file description heading.

1.2 Introduction

This manual is designed to help the Seaglider users identify and interpret files they will encounter on the basestation.

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1.2.1 List of files found on the basestation

(using SG132, dive 55, for example filenames)

These files are described in the document below.

processed_files.cache **baselog_080221110101** **baselog.log** **sg_calib_constants.m** **cmdfile** **comm.log**	
p1230055.eng **p1230055.log**	p indicates that these files have been processed by the basestation. They are the files that contain information from the glider, for use by the pilot, operator, and scientist.
p1230000.prm	This file is sent at the end of a self test. Contains a list of the parameters and their settings at the time of the self test, and some information about the transmission of files during the self test.
cmdedit.log **targedit.log** **sciedit.log**	These files are made by the basestation, and document each change made to the command file, targets file, and science file using cmdedit, targedit, and sciedit.
comm_merged.log	Merged comm log and history
history.log	Record of shell commands
cmdfile.0 **targets.0** **science.0** **p1230055.000.pdos**	Every time a cmdfile, targets file, or science file is taken up by the glider, it is saved on the basestation and renamed to include the dive number. PDOS command files are also saved, but already include the dive number, so they are saved with a serial number. If there are multiple calls on one surfacing, a cmdfile is sent each time, and a serial number is added after the dive number.

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These files are intermediates found on the basestation. They are used to create the processed files documented in this manual. Characters in the file names indicate the following: st : The file is from a self-test. If from a normal dive, this prefix will be pt b: has had duplicate sections removed "Bogue Syndrome processing" 1a: has been stripped of the padding characters added for transmission from the Seaglider. u: uncompressed z: zipped r: raw; a reconstruction of the raw ASCII text file on the glider x: The following sequence number is in the hexidecimal system	**st0055du.1a.x00** **st0055du.r** **st0055du.x00**	d indicates that these intermediate files will be used to create a data file.
	st0055lu.1a.x00 **st0055lu.x00**	l indicates that these intermediate files will be used to create a log file.
	st0055kz.1a.x02 **st0055kz.1a.x03s** **t0055kz.b.1a.x04** **st0055kz.b.x04** **st0055kz.r** **st0055kz.x00** **st0055kz.x01**	k indicates that these intermediate files will be used to create a capture file.
	st0055kz.x00.PARTIAL.1	Partial files appear when the basestation does not receive a complete file from the Seaglider, and is unable to process it. Transmission errors are addressed in the Communications Log section of this document, and in the Seaglider Pilot's Guide.

1.2.2 Data Flow map

Chapter 2

File descriptions

This section describes the files relevant to the Seaglider user. Where appropriate, excerpts from real files, with explanatory annotation, are shown.

iRobot basestation software has the ability to create the following files, however iRobot does not support these files.

- .asc
- .dat
- .nc
- .gz
- mission_ts_nc
- mission_pro.nc
- pro
- bpo

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- dn_kkyy
- up_kkyy

2.1 Processed files

2.1.1 Log file

(p1230055.log)

One log file is made for each dive. The first portion of the data is a list of the parameters and their values for that dive. For more information, see the Parameter Reference Manual. The second section, beginning with the entry $GPS1, contains information concerning the predive period at the surface. The $GC-labeled lines describe motor actions (pitch, roll, or VBD), one line per motor move. The information listed after the $GC lines are data collected at the end of the dive (surface maneuver data, final temperature reading, etc.). Some of this data is from the previous surfacing (before the start of the current dive). Not all Seaglider systems will report all of the lines that appear in the example given here, because the devices installed vary among Seaglider systems.

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Example Log file

version: 66.06 Seaglider operating code
glider: 123 Seaglider serial number
mission: 1 counter settable by pilot or launch operator
dive: 055 dive number
start: 7 17 106 19 24 20, day and time (UTC) of start of dive

- month
- day of month
- year after 1900
- hour (UTC, starting with 0)
- minute (UTC, starting with 0)
- second (UTC, starting with 0)

data:
$ID,123
$MISSION,1
$DIVE,55
$D_SURF,2
$D_FLARE,3
$D_TGT,990
$D_ABORT,1090
$D_NO_BLEED,500
$D_FINISH,0
$T_DIVE,220
$T_MISSION,275
$T_ABORT,1440
$T_TURN,225
$T_TURN_SAMPINT,5
$T_NO_W,120
$USE_BATHY,0
$USE_ICE,-1
$D_OFFGRID,1001
$T_WATCHDOG,10
$RELAUNCH,1
$APOGEE_PITCH,-5

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$MAX_BUOY,225
$COURSE_BIAS,0
$GLIDE_SLOPE,30
$SPEED_FACTOR,1
$RHO,1.0275
$MASS,52202
$NAV_MODE,0
$FERRY_MAX,60
$KALMAN_USE,1
$HD_A,0.003
$HD_B,0.0099999998
$HD_C,9.9999997e-06
$HEADING,-1
$ESCAPE_HEADING,0
$ESCAPE_HEADING_DELTA,10
$TGT_DEFAULT_LAT,21
$TGT_DEFAULT_LON,-158.3
$TGT_AUTO_DEFAULT,0
$SM_CC,400
$N_FILEKB,4
$FILEMGR,0
$CALL_NDIVES,1
$COMM_SEQ,0
$N_NOCOMM,1
$N_NOSURFACE,0
$PITCH_MIN,331
$PITCH_MAX,3664
$C_PITCH,2720
$PITCH_DBAND,0.1
$PITCH_ADJ_DBAND,0.5
$PITCH_ADJ_GAIN,0.03
$PITCH_MAXERRORS,1
$ROLL_DEG,45
$ROLL_MAX,4000
$ROLL_MIN,120
$PITCH_CNV,0.0046000001
$P_OVSHOOT,0.039999999
$PITCH_GAIN,16
$PITCH_TIMEOUT,20
$PITCH_AD_RATE,150
$UPLOAD_DIVES_MAX,-1

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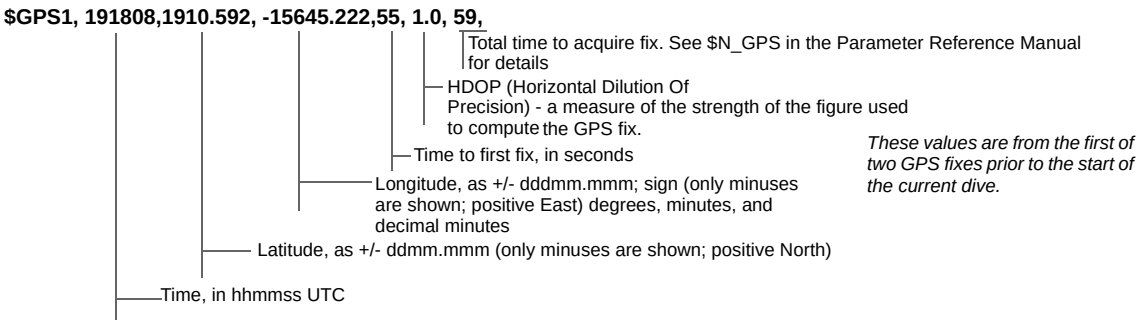
$CALL_TRIES,5
$CALL_WAIT,60
$CAPUPLOAD,0
$CAPMAXSIZE,100000
$T_GPS,15
$N_GPS,20
$T_GPS_ALMANAC,0
$T_GPS_CHARGE,-47579.566
$T_RSLEEP,3
$C_ROLL_DIVE,2150
$C_ROLL_CLIMB,2225
$HEAD_ERRBAND,10
$ROLL_CNV,0.028270001
$ROLL_TIMEOUT,15
$R_PORT_OVSHOOT,62
$R_STBD_OVSHOOT,42
$ROLL_AD_RATE,500
$ROLL_MAXERRORS,0
$ROLL_ADJ_GAIN,0
$ROLL_ADJ_DBAND,0
$VBD_MIN,704
$VBD_MAX,3940
$C_VBD,2956
$VBD_DBAND,2
$VBD_CNV,-0.24529999
$VBD_TIMEOUT,720
$PITCH_VBD_SHIFT,0.0020000001
$VBD_PUMP_AD_RATE_SURFACE,5
$VBD_PUMP_AD_RATE_APOGEE,4
$VBD_BLEED_AD_RATE,8
$UNCOM_BLEED,20
$VBD_MAXERRORS,1
$CF8_MAXERRORS,0
$AH0_24V,91.800003
$AH0_10V,61.200001
$MINV_24V,19
$MINV_10V,8
$FG_AHR_10V,6.94801 $FG_AHR_24V,6.73398 $PHONE_SUPPLY,2
$PRESSURE_YINT,-9.1756201
$PRESSURE_SLOPE,9.1530041e-05
$AD7714Ch0Gain,64

See Parameter Reference Manual for information on parameters reported in the log file.

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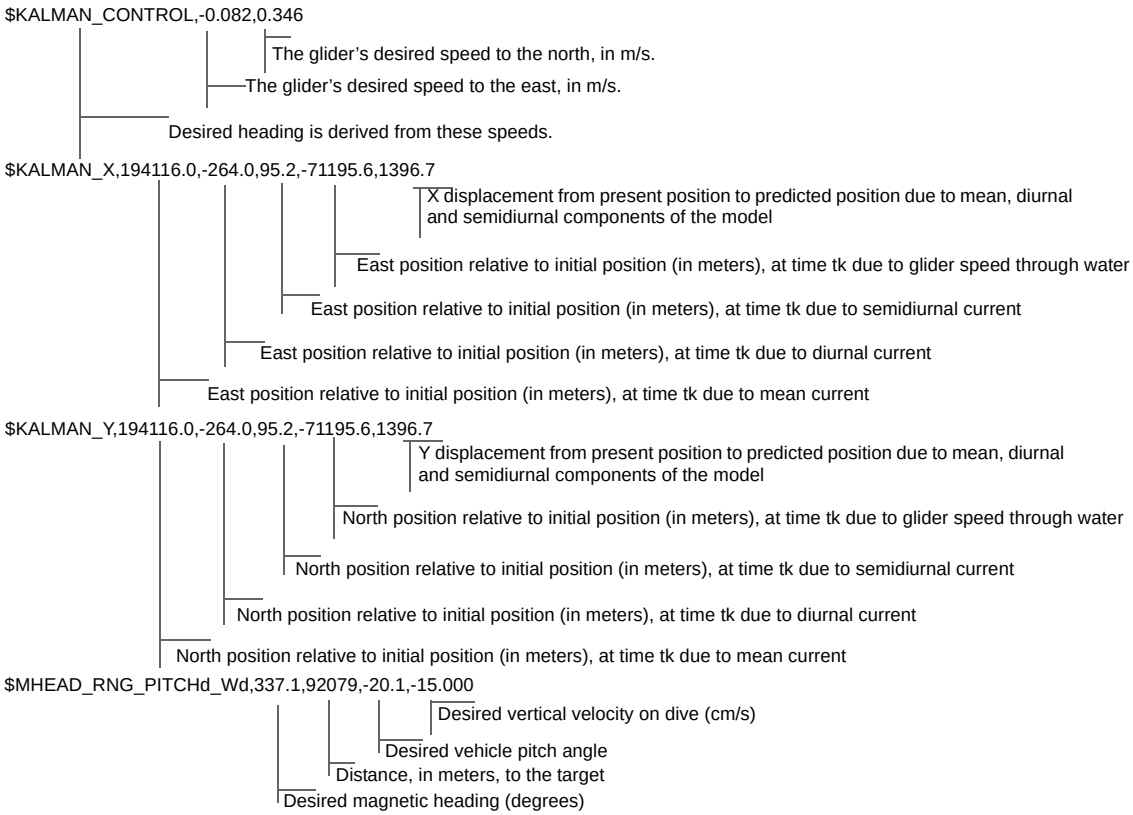
$TCM_PITCH_OFFSET,0
$TCM_ROLL_OFFSET,0
$ALTIM_BOTTOM_PING_RANGE,0
$ALTIM_TOP_PING_RANGE,0
$ALTIM_BOTTOM_TURN_MARGIN,0
$ALTIM_TOP_TURN_MARGIN,0
$ALTIM_TOP_MIN_OBSTACLE,1
$ALTIM_PING_DEPTH,0
$ALTIM_PING_DELTA,0
$ALTIM_FREQUENCY,13
$ALTIM_PULSE,2
$ALTIM_SENSITIVITY,4
$XPDR_VALID,0
$XPDR_INHIBIT,90
$INT_PRESSURE_SLOPE,0.0097660003
$INT_PRESSURE_YINT,0
$MOTHERBOARD,4
$DEVICE1,2
$DEVICE2,20
$DEVICE3,37
$DEVICE4,-1
$DEVICE5,-1
$DEVICE6,-1
$COMPASS_DEVICE,33
$PHONE_DEVICE,48
$GPS_DEVICE,32
$RAFOS_DEVICE,-1
$XPDR_DEVICE,24
$SIM_W,0
$SIM_PITCH,0
$SEABIRD_T_G,0.004327164
$SEABIRD_T_H,0.00064159534
$SEABIRD_T_I,2.4326842e-05
$SEABIRD_T_J,2.4823044e-06
$SEABIRD_C_G,-10.256908
$SEABIRD_C_H,1.181479
$SEABIRD_C_I,-0.0036624616
$SEABIRD_C_J,0.00030102869

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$GPS1, 191808,1910.592, -15645.222,55, 1.0, 59,
Total time to acquire fix. See $N_GPS in the Parameter Reference Manual for details
HDOP (Horizontal Dilution Of Precision) - a measure of the strength of the figure used to compute the GPS fix.
Time to first fix, in seconds
Longitude, as +/- dddmm.mmm; sign (only minuses are shown; positive East) degrees, minutes, and decimal minutes
Latitude, as +/- ddmm.mmm (only minuses are shown; positive North)
Time, in hhmmss UTC
These values are from the first of two GPS fixes prior to the start of the current dive.

$_CALLS,1	Total number of calls that were made in an attempt to connect on the previous surfacing.
_XMS_NAKs,0	Total number of transfers that ended with a NAK (No Acknowledgements) on the previous surfacing.
$_XMS_TOUTs,0	Total number of transfers that ended without a timeout on the previous surfacing.
$_SM_DEPTHo,2.36	Glider-measured depth, in meters, while the glider is at the surface at the end of the previous dive.
$_SM_ANGLEo,-58.8	Glider-measured angle at the surface, at the end of the previous dive, in degrees
$GPS2,192327,1910.511, -15645.083,18,1.5,19,9.6	These values are from the second GPS fix prior to the start of the current dive. See the "Canonical Dive Profile" in the Seaglider Pilot's Guide for further details on where the GPS fix is taken.
$SPEED_LIMITS,0.260,0.356	The minimum and maximum horizontal speed attainable by the Seaglider on this dive, in meters per second. These values are based on the minimum and maximum dive angles and the allowable buoyancyforce. The minimum speed corresponds to the maximum dive angle; the maximum speed is obtained as the minimum value of the horizontal speed.
$TGT_NAME,WPT5	The name of the active target of this dive. See theTargets File section for details.
$TGT_LATLONG,2000.000,-15640.000	The latitude and longitude, in +/-ddmm.mmm and +/- dddmm.mmm format, for the target of this dive.
$TGT_RADIUS,1852.000	The radius for the active target for this dive, in meters.

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$KALMAN_CONTROL,-0.082,0.346
The glider's desired speed to the north, in m/s.
The glider's desired speed to the east, in m/s.
Desired heading is derived from these speeds.
$KALMAN_X,194116.0,-264.0,95.2,-71195.6,1396.7
X displacement from present position to predicted position due to mean, diurnal and semidiurnal components of the model
East position relative to initial position (in meters), at time tk due to glider speed through water
East position relative to initial position (in meters), at time tk due to semidiurnal current
East position relative to initial position (in meters), at time tk due to diurnal current
East position relative to initial position (in meters), at time tk due to mean current
$KALMAN_Y,194116.0,-264.0,95.2,-71195.6,1396.7
Y displacement from present position to predicted position due to mean, diurnal and semidiurnal components of the model
North position relative to initial position (in meters), at time tk due to glider speed through water
North position relative to initial position (in meters), at time tk due to semidiurnal current
North position relative to initial position (in meters), at time tk due to diurnal current
North position relative to initial position (in meters), at time tk due to mean current
$MHEAD_RNG_PITCHd_Wd,337.1,92079,-20.1,-15.000
Desired vertical velocity on dive (cm/s)
Desired vehicle pitch angle
Distance, in meters, to the target
Desired magnetic heading (degrees)

$D_GRID,990 The depth, in meters, to the apogee maneuver, as read from the currently active bathymetry map.

$GCHEAD,st_secs,pitch_ctl,vbd_ctl,depth,ob_vertv, data_pts,end_secs,pitch_secs,roll_secs,vbd_secs, vbd_i,gcphase,pitch_i,roll_i,pitch_ad, roll_ad,vbd_ad,pitch_retries,pitch_errors,roll_retries,roll_errors, vbd_retries,vbd_errors

st_secs: Elapsed time from the start of the dive to the start of the GC

pitch_ctl: Position of the pitch mass, in centimeters, relative to

$C_PITCH (positive aft)

vbd_ctl: Position of the VBD, in cc, relative to $C_VBD (positive buoyant)

depth: Depth at the start of GC, in meters

ob_vertv: Observed vertical velocity, in centimeters per second

data_pts: Number of data records collected thus far in the dive

end_secs: Elapsed time from the start of the dive to the end of the GC

pitch_secs: Number of seconds the pitch motor was on

roll_secs: Number of seconds the roll motor was on

vbd_secs: Number of seconds the VBD was on

vbd_i: Average current used by the VBD, in amps

gcphase: GC phase, encoded as follows

1: Pitch change
2: VBD change
3: Roll
4: Turning (passive)
5: Roll back (to center)
6: Passive mode (waiting)

pitch_i: Average current used by the pitch motor, in amps

roll_i: Average current used by the roll motor, in amps

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pitch_ad: Position of the pitch motor, in AD counts, at the end of the motor move

roll_ad: Position of the roll motor, in AD counts, at the end of the motor move

vbd_ad: Position of the VBD, in AD counts, at the end of the motor move

pitch_retries: number of retries (instantaneous AD rate of move less than $PITCH_AD_RATE) during this motor move

pitch_errors: number of pitch motor errors (timeouts) during this motor move

roll_retries: number of retries (instantaneous AD rate of move less than $ROLL_AD_RATE) during this motor move

roll_errors: number of roll motor errors (timeouts) during this motor move

vbd_retries: number of retries (instantaneous AD rate of move less than $VBD_PUMP_AD_RATE_APOGEE, $VBD_PUMP_AD_RATE_SURFACE, or $VBD_BLEED_RATE as appropriate) during this motor move

vbd_errors: number of VBD errors (timeouts) during this motor move

$GC,15,-1.70,-218.4,0.0,0.0,0,59,0.00,0.00,-41.92,0.000,2,0.000,0.000,326,2165,2436,0,0,0,0,0,0

$GC 60,-1.70,-219.0,3.2,-3.9,7,115,11.95,2.45,-34.53,0.000,4,0.180,0.062,2341,3533,3851,0,0,0,0,0,0

$GC,275,-1.70,-219.0,47.8,-22.3,47,281,0.00,2.28,0.00,0.000,6,0.000,0.025,2341,2181,3853,0,0,0,0,0,0

$GC,596,-1.70,-219.0,120.2,-20.3,108,601,0.00,2.50,0.00,0.000,4,0.000,0.045,2341,759,3854,0,0,0,0,0,0

$GC,665,-1.70,-219.0,134.5,-21.4,114,672,0.00,2.33,0.00,0.000,6,0.000,0.023,2342,2149,3855,0,0,0,0,0,0

...lines omitted...

$GC,13111,2.12,489.2,70.3,12.2,557,13165,0.00,2.53,46.45,0.633,4,0.000,0.048,3183,832,959,0,0,0,0,0,0

$GC,13278,2.24,526.9,48.1,13.3,588,13317,0.08,2.38,31.85,0.607,6,0.047,0.025,3213,2229,806,0,0,0,0,0,0

$STATE,20661,end climb,SURFACE_DEPTH_REACHED

$STATE,20661,begin surface coast

$FINISH,1.9,1.008786

- 1.008786: Density of water, in grams per cc, at the first sample taken after reaching $D_SURF (or $D_FINISH, if enabled)
- 1.9: Depth of glider, in meters at the first sample taken after reaching $D_SURF (or $D_FINISH, if enabled)

$SM_CCo,2031,75.53,0.653, 0,0,239,530.09

- 530.09: Final position of the VBD after the SM pump in cc's
- 239: Final position of the VBD after the SM pump, in AD counts
- 0: Number of errors during the SM pump
- 0: Number of retries during the SM pump
- 0.653: Average current for the VBD during the SM pump, in amps
- 75.53: Time in seconds for the SM pump
- 2031: Time in seconds from the start of the dive to when the Surface Maneuver (SM) pump was started

$SM_GC 1.25,11.30,0.00,0.00,0.038,0.000,0.000,424,2272,1263,-10.22,0.34,438.35

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$IRIDIUM_FIX,1904.66,12231.77,091207,191902

$TT8_MAMPS,0.02301	Power draw on the 10 V power pack, in amps, measured at the end of the dive. This measurement can be used to determine if devices are being left on.
$HUMID,1789	Pressure inside the pressure hull, in PSIA.
$INTERNAL_PRESSURE,7.15848	Pressure inside the pressure hull, in PSIA.
$TCM_TEMP,23.60	Last temperature reading taken from the compass, in degrees C.
$XPDR_PINGS,8	Number of times the transponder commanded a ping on the dive. This could be altimeter pings, or pings in response to something that sounded like an interrogation.
$ALTIM_BOTTOM_PING, 875.1,26.8	Depth of the glider, and altimeteter-detected distance to bottom.

$24V_AH,23.3,21.710

Total amp-hours consumed on the 24V battery since the last reset of the battery meters (usually when new batter are installed).

The minimum measured battery voltage (measured during active phase) on the 24V battery pack, in volts.

$10V_AH,10.0,17.969 Same as $24V_AH, but for 10V battery pack

$FG_AHR_24Vo,6.819

Cumulative A-hr consumed from the 24V battery pack as tracked by the supervisor fuel gauge and recorded at the end of the dive. Only meaningful on a RevC and later motherboard

$FG_AHR_10Vo,6.967 Same as $FG_AHR_24Vo, but for 10V battery pack. Only meaningful on a RevC or later motherboard'

$DEVICES,Pitch_motor,Roll_motor,VBD_pump_during_apogee,
VBD_pump_during_surface,VBD_valve,Iridium_during_init,
Iridium_during_connect,Iridium_during_xfer, Transponder_ping,
Mmodem_TX,Mmodem_RX,GPS,TT8,LPSleep,
TT8_Active,TT8_Sampling,TT8_CF8,TT8_Kalman,Analog_circuits,
GPS_charging,Compass,RAFOS,Transponder.

Provides the titles of the numbers in the next two lines ($DEVICE_SECS and $DEVICE_MAMPS). The meaning of each title is listed below.

Pitch_motor: All use of the pitch motor, in the units given in the next two lines
Roll_motor: All use of the roll motor, in the units given in the next two lines
VBD_pump_during_apogee: Use of the VBD pump during active mode
VBD_pump_during_surface: Use of the VBD pump outside of the dive
VBD_valve: Any use of the VBD valve
Iridium_during_init: Use of the phone related to turning the phone on
Iridium_during _connect: Use of the phone while connecting to the basestation
Iridium_during_xfer: Use of phone during a file transfer
Transponder_ping: Use of the transponder during an active ping
Mmodem_TX:
Mmodem_RX:
GPS: All use of the GPS for fix acquisition
TT8: Use of the TT8 at 2 MHz
LPSleep: Use of the TT8 under low power sleep
TT8_Active: Use of the TT8 in active mode
TT8_Sampling: Use of the TT8 while sampling sensors
TT8_CF8: Use of the TT8 while accessing the flash
TT8_Kalman: Use of the TT8 while running the Kalman filter code
Analog_circuits: Use of the analog circuitry, including the pressure sensor
GPS_charging: Use of the auxiliary GPS charging circuit
Compass: Use of the compass
RAFOS: Use of the RAFOS receiver
Transponder: Total use of the transponder (including ping time)

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$DEVICE_SECS,28.900,130.775,625.775,0.000,0.000,
32.521,48.298,129.845,2.000,81.068,563.712,9134.856,
711.991,3431.997,344.516,33.374,1911.731,0.000, 3107.613,0.000,0.186

Reports the number of seconds each device was powered on during the dive.

$DEVICE_MAMPS,180.245,87.438,1307.735,0.000,0.000,103.000,160.000,22
3.000,420.000,50.000,19.800,2.190,19.800,
39.800,45.800,81.800,12.000,0.000,8.000,0.000,30.000

Reports the maximum current (in mA) drawn by each device listed in $DEVICES.

$SENSORS,SBE_CT,SBE_O2,WL_BB2F,nil,nil,nil

SBE_CT: Seabird CT sensor. By convention, this is configured as the first device.
SBE_O2: Seabird O2 sensor.
WL_BB2F: Wetlabs BB2F combination backscatter sensor and fluorometer.
Optode: Optode oxygen sensor.
nil: indicates that no sensor is installed in this position.

Similar to $DEVICES, in simply providing titles for the numbers listed in the following two columns ($SENSOR_SECS and $SENSOR_MAMPS). Each title represents one of the sensors installed on the Seaglider, as described here.

$SENSOR_SECS,2182.877,1551.421,748.579,0.000,0.000,0.000

Reports the number of seconds each sensor was powered on during the dive.

$SENSOR_MAMPS,24.000,19.000,105.000,0.000,0.000,0.000

Reports the maximum current drawn by each sensor during the dive.

$DATA_FILE_SIZE,36111,664

- 664 — The number of data samples taken during the dive
- 36111 — The total size of the data file in bytes

$CFSIZE,260165632,248328192

- 248328192 — The available free space on the compact flash card
- 260165632 — The total capacity of the compact flash card

$ERRORS, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0

- 0 — Count of how many GPS PPS (pulse per second) errors
- 0 — Number of times the GPS did not provide data from $GPRMC (Position and time) or $GPGGA (Fix Data) records within the 2 second timeout.
- 0 — Number of VBD retries
- 0 — Number of roll retries
- 0 — Number of pitch retries
- 0 — Number of VBD errors
- 0 — Number of roll errors
- 0 — Number of pitch errors
- 0 — Number of CF8 retries while closing files
- 0 — Number of CF8 retries while writing files
- 0 — Number of CF8 retries while opening files
- 0 — Number of CF8 errors while closing files
- 0 — Number of CF8 errors while writing files
- 0 — Number of CF8 errors while opening files
- 0 — The number of spurious interrupts. Spurious interrupts may result from divide by zero or memory dereference problems. They may also arise from interrupt contention. Occasional isolated spurious interrupts are normal.
- 0 — Buffer Overruns-The number of times the log file output is longer than the internal buffer length. For each of the buffer overruns, the output is truncated to fit in the buffer, resulting in lost logfile output.

$GPS,170706,231510,1911.874,-15644.574,40,1.4,40,9.6

- 9.6 — Magnetic variation (degrees, positive E)
- 170706 — UTC

These values are from the most recent GPS fix, which corresponds to the end of the current dive.

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2.1.2 Eng file

The engineering files (*.eng) are created on the Base Station. They contain Seaglider control state and attitude observations in engineering units. Data from installed sensors may also be present here. The first 9 columns are always present. The remaining columns vary and are dependent upon the sensors that are installed. The sensor serial number. which is entered during installation and configuration of the sensor(s) on the glider, is contained in the column header associated with that particular sensor line. The column titles are described as follows:

elaps_t_0000: Time, in seconds, since 0000UTC of the current day
elaps_t: Time, in seconds, since the start of the dive
depth: Depth, in centimeters, at the start of the sample
head: Vehicle heading, in degrees magnetic
pitchAng: Vehicle pitch at the start of the sample, in degrees; positive nose-up
rollAng: Vehicle roll at the start of the sample, in degrees; positive starboard wing down (rolled to starboard)
pitchCtl: Pitch mass position relative to $C_PITCH, in centimeters; positive nose up
rollCtl: Roll mass position, in degrees relative to $C_ROLL_DIVE or $C_ROLL_CLIMB; positive starboard wing down
vbdCC: VBD value relative to $C_VBD, in cc's; positive buoyant
sbect.condFreq: Conductivity frequency, in Hertz
sbect.tempFreq: Temperature frequency, in Hertz
sbe43.O2Freq: Oxygen concentration, in Hertz
wl[ser #].ref1: Wavelength 1 reference, in A/D counts
wl[ser #].sig1: Wavelength 1 backscatter, in A/D counts
wl[ser #].ref2: Wavelength 2 reference, in A/D counts
wl[ser #].sig2: Wavelength 2 backscatter, in A/D counts
wl[ser #].ref3: Wavelength 3 reference, in A/D counts
wl[ser #].sig3: Wavelength 3 backscatter, in A/D counts
wl[ser #].CDOMref1: ppb in A/D Counts (and only If equipped with a CDOM fluorometer)
wl[ser #].CDOMsig1: ppb in A/D Counts (and only If equipped with this CDOM fluorometer)
wl[ser #].Chlref1: µg/l in A/D Counts (and only If equipped with a Chlorophyll fluorometer)
wl[ser #].Chlsig1: µg/l in A/D Counts (and only If equipped with this Chlorophyll fluorometer)
wl[ser #].temp1: Temperature, in degrees C; Recorded but not used by Visualization software
wl[ser #].Chlref1: Chlorophyll signal output 1 reference, in A/D counts
wl[ser #].Chlsig1: Chlorophyll signal output 1 backscatter, in A/D counts
wl[ser #].Cdomref1: CDOM signal output 1 reference, in A/D counts
wl[ser #].Cdomsig1: CDOM signal output 1 backscatter, in A/D counts
aa[ser #].O2: O2 Concentration in µM
aa[ser #].AirSat: Air Saturation in %; Recorded but not used by Visualization software
aa[ser #].Temp: Temperature, in degrees C; Recorded but not used by Visualization software
aa[ser #].CalPhase: Recorded but not used by Visualization software
aa[ser #].TCPhase: Recorded but not used by Visualization software
qsp[ser #].PARuV: quantum response, in Volts (output units configured at factory)

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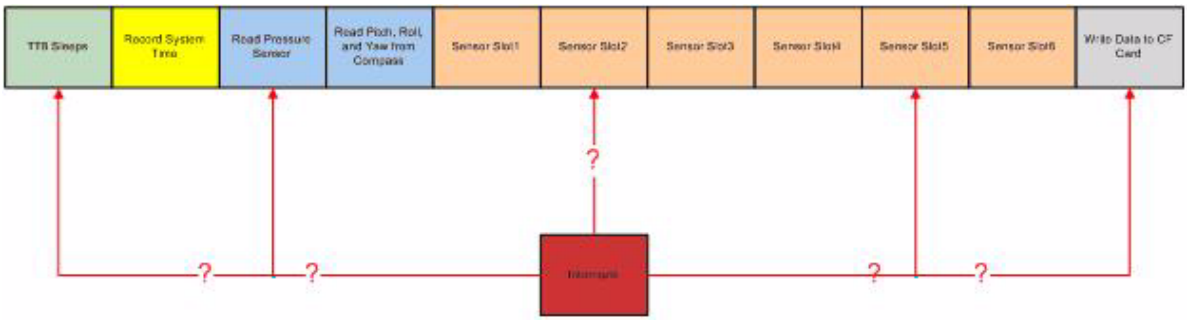


Figure B-1. Description of timing of sampling of OSI sensors recorded in .eng file

OSI sensors are sampled by the glider sequentially in the order shown in Figure B-1. The sampled data is processed by the base station to create the .eng file. The sequence is as follows:

Step #	Action
Step 1	TT8 Sleeps if the science file specifies that it is not time to sample yet.
Step 2	Record system time and save this to log with the data as the timestamp for this line of the engineering file
Step 3	Read the Paine pressure sensor installed on the glider
Step 4	Read the SP3004D compass installed on the glider
Step 5 - Step 10	Check each sensor slot sequentially for an installed sensor. If that slot has a sensor, sample it, then proceed to next sensor. If the next slot is empty, proceed directly to Step 11.
Step 11	Write out a new row of data to the .eng file including the system time, pressure reading, compass data, vehicle control positions (VBD and mass shifter), guidance and control phase state, and finally the sensor data in each slot sequentially, until all sensor data collected is written.

At any time during the sequence of steps described above, it is possible for the processor to be interrupted. Interruptions in data sampling occur most often when the mass shifter moves to change the glider's attitude; however, other tasks carried out by the glider may also cause interruptions in data sampling.

Interruptions that occur and are completed while the TT8 sleeps will not have a net affect on the sampling lead and lag times. However, if the interrupt occurs anywhere else in the sequence, lead and lag times cannot be estimated accurately due to the fact that interruptions are aperiodic and vary in duration. In addition, there is no information that is recorded by the glider that can help ascertain when these aperiodic interruptions occur. Consequently, attempts to calculate lead and lag times of sensors relative to the recorded time sequence are, at best, estimates only and will have associated error that cannot be accurately quantified.

The following is an example to illustrate the process above. iRobot operated a glider on 1000 meter dives in which the sampling rate was configured to be the same throughout numerous dives. During the mission 97% of samples were completed in 5-7 seconds. From this use-case, it is reasonable to assume that 2 second accuracy of sample times is achievable for the vast majority of data points.

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The following chart shows the expected time after the timestamp each step will take to complete (Note individual systems will vary as each sensor will have a slightly different sample time):

Step #	Action	Time To Complete
Step 1	TT8 Sleep	N/A
Step 2	Record System Time	1 millisecond
Step 3	Read the Paine pressure sensor installed on the glider	25 millisecond
Step 4	Read the SP3004D compass installed on the glider	1425 millisecond
Step 5	Sample CT Sail	875 millisecond
Step 6	Sample SBE DO	1250 millisecond
Step 7	Sample Aanderaa Optode	2125 millisecond
Step 8	Sample PAR	175 millisecond
Step 9	Sample WetLabs Triplet (BB2FL, BBFL2, FL3, or BB3)	1825 millisecond
Step 10	Empty slot	N/A
Step 11	Write data out to compact flash card	100 millisecond

Based upon the sensor configuration above, a single sensor sample cycle would take approximately 8 seconds.

So for example, if we have a vehicle with the following configuration:

- a CT sail in slot 1
- an Aanderaa in slot 2
- an SBE DO in slot 3, and
- a WL BB2FL in slot 4

and the times are recorded:

- Start time from eng file file: 8 22 112 11 11 11
- Second column of sensor sample is elapsed seconds since start time: 156.356

We can then estimate the specific times of each sample as described in the following table:

Step #	Action	Time Sample Taken
Step 2	Record System Time	8/22/2012 11:13:47.365 UTC
Step 3	Read the Paine pressure sensor installed on the glider	8/22/2012 11:13:47.381 UTC
Step 4	Read the SP3004D compass installed on the glider	8/22/2012 11:13:48.806 UTC
Step 5	Sample CT Sail	8/22/2012 11:13:49.681 UTC
Step 6	Sample Aanderaa Optode	8/22/2012 11:13:51.806 UTC
Step 7	Sample SBE DO	8/22/2012 11:13:53.056 UTC

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Step #	Action	Time Sample Taken
Step 8	Sample WetLabs BB2FL	8/22/2012 11:13:54.881 UTC
Step 11	Write data out to compact flash card	8/22/2012 11:13:54.991 UTC

Sensors Equations: Convert Sensor Output to Engineering Units

1 WET Labs

1.1Scattering Meter

The scattering meter comes with a calibration sheet containing the calibration constants to be used to convert A/D Counts to engineering units. These constants are placed into the file sg_calib_constants.m which is provided with your software by our manufacturing facility. There should be no need to edit the contents of this file unless your sensor is replaced or recalibrated. In such a case, please contact technical support for further assistance.

In addition to the calibration constants on the calibration sheet, the calibration sheet also contains the equation that is used by your software to convert from A/D Counts to engineering units. As of the writing of this manual, the general form of the conversion equation is:

$$\beta(\theta_c)m^{-1}sr^{-1} = \text{Scale Factor} * (\text{Output} - \text{Dark Counts})$$

1.2Fluorometer

Your WET Labs sensor may be equipped with one or more fluorometers (e.g., CDOM, Chlorophyll). Each of the fluorometers will come with its own calibration sheet containing the calibration constants to be used to convert A/D Counts to engineering units. These constants are placed into the file sg_calib_constants.m which is provided with your software by our manufacturing facility. There should be no need to edit the contents of this file unless your sensor is replaced or recalibrated. In such a case, please contact technical support for further assistance.

In addition to the calibration constants on the calibration sheet, the calibration sheet also contains the equation that is used by your software to convert from A/D Counts to Engineering Units. As of the writing of this manual, the general form of the equation used by the Visualization software to convert from A/D Counts to Engineering Units is:

Fluorometer (Engineering Units) = Scale Factor * (Output - Dark Counts)

where

- Engineering Units will vary depending upon the fluorometer that is delivered with your sensor. The following are examples of fluorometers and their engineering units:
  - CDOM: ppb
  - Chlorophyll: µg/l
- Output is the output from the sensor

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- Scale Factor is from the calibration sheet
- Dark Counts is from the calibration sheet



2

2.1Photosynthetically Active Radiation (PAR) Sensor

The PAR Sensor comes with a calibration sheet containing the calibration constants to be used to convert voltage to engineering units. These constants are placed into the file sg_calib_constants.m which is provided with your software by our manufacturing facility. There should be no need to edit the contents of this file unless your sensor is replaced or recalibrated. In such a case, please contact technical support for further assistance.

As of the writing of this manual, the general form of the equation used by the Visualization software to convert from voltage to engineering units is:

$$\text{Volt}/(\mu\text{E}/\text{cm}^2\text{sec}) = (\text{Sensor Output} - \text{Sensor Dark}) / (\text{Scale Factor} * 1000\ \text{mV/v})$$

where

- Sensor Output is the data returned by the sensor
- Sensor Dark is from the calibration sheet
- Scale Factor is the **Wet** (and not the dry) scale factor from the calibration sheet



3

3.1SBE 43F Dissolved Oxygen (DO) Sensor

The SBE 43F DO Sensor comes with a calibration sheet containing the calibration constants to be used to convert frequency to engineering units. These constants are placed into the file sg_calib_constants.m which is provided with your software by our manufacturing facility. There should be no need to edit the contents of this file unless your sensor is replaced or recalibrated. In such a case, please contact technical support for further assistance.

NOTE: These constants are only used with the Visualization software when the SBE 43F DO sensor is attached directly to the end-cap port on Seaglider. These constants are NOT used by the Visualization software when the SBE43F DO sensor is attached to the GPCTD.

As of the writing of this manual, the general form of the equation used by the Visualization software to convert from frequency voltage to engineering units is:

$$O2 = Soc*(output+Foffset)*(1.0+A*T+B*T2+C*T3)*Oxsat*\exp\{E*P/(T+273.15)\}$$

where

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- Output = the frequency output from the SBE 43F sensor
- Soc, A, B, C, E = constants from the calibration sheet
- T = temperature obtained from a GPCTD or a Microcat C-T Recorder (SBE 37-SM)
- P = pressure obtained from a GPCTD or a Microcat C-T Recorder (SBE 37-SM)
- Oxsat(T,S) = the oxygen saturation calculated per Weiss (1970)*

*WEISS, R. F. 1970. The solubility of nitrogen, oxygen and argon in water and seawater. Deep-Sea Res. 17: 721-735.

2.1.3 Capture file

(p1230055.cap)

The capture file contains information about all of the actions the Seaglider took during the dive. It captures the output written to the console while the Seaglider is operating. Capture files are a great source of information on the glider's performance, especially in error analysis and debugging. For more information on the use of capture files, please see the Capture File section in the Seaglider Pilot's Guide.

The format of the capture file is not as hard and fast as other file formats, but it usually conforms to that shown below:

time, service, output level, text

Example Capture file

2966.752,N,Capture file opened

Descriptive text; often what action was taken, and sometimes the reason fo the action.

Output level. There are three letters that can appear in this position: N, C, or D. N indicates normal output level. C stands for critical, and means that only output considered critical to glider function will be printed. For the most part, this consists of dire problems with hardware or software, like motor errors or buffer overruns. D stands for Debug, and is used for extended diagnostics.

This output can be quite voluminous and it is recommended that this only be set on specific services when it is known that some needed output will be captured. Most services do not have output in this level currently, but work is ongoing to add extended diagnostics under this output level.

TIme, in seconds, since the start of the dive

2967.080,HTT8,N,Writing NVRAM...done.

2995.325,HGPS,N,Acquiring GPS fix ...

2998.197,HGPS,N,VVVVA

270407, 140904, 4806.097168, -12222.047852 1.500000 13/13 seconds

3009.584,HTT8,N,Updating parameter $T_GPS_CHARGE to -13320.147

The capture file gives the following information regarding every pitch, roll and VBD maneuver:

876.356,HROLL,N,Roll commanded from 39.80 deg (3384) to 0.00 deg (1976)...

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877.415,HROLL,N,34.5 deg (ad: 3195) Updating parameter $R_PORT_OVSHOOT to 18

880.082,SMOTOR,N,MOTOR_DONE: ticks: 1 max 24v: 0.006A avg 24v: 0.006A

880.215,SMOTOR,N,GC TICKS/TIME: 117/119500

880.304,HROLL,N,done.

If problems occur, they are reported here.

132.434,HPITCH,N,Pitch completed from -8.87 cm (1472) to -1.24 cm (3130) took 17.0 sec 0.292A (0.377A peak) 97 AD/sec 681 ticks; 10 retries

The capture file also describes changes between dive phases:

839.259,SDIVE,N,Leaving climb state due to SURFACE_DEPTH_REACHED

839.402,SDIVE,N,Entering surface coast state

839.570,SDIVE,N,Reached SD,Wo = 0.064493,6 more points

Seaglider calculated that it should take this many more samples before beginning surface maneuver

Vertical velocity when surface depth reached

Surface depth

2.2 Processing control files

This section includes files that are used by the pilot to monitor and, when necessary, modify, how the basestation processes Seaglider data.

2.2.1 Communications log

(comm.log)

The "comm log" file is appended during each communication session, and so is a complete record of the Seaglider system’s communications over an entire deployment. It is a plain-text file that resides in the Seaglider home directory. Running tail -f comm.log in the Seaglider home directory during (or while waiting for) communication sessions is a useful monitor.

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Example comm.log

Connected at Sun Dec 2 19:17:03 PST 2007 Date and time of communications session

0055:0:1:0 GPS,031207,031455,1855.179,12237.359,41,1.3,41,-2.1

- Magnetic variation
- Total time to acquire fix. See $N_GPS in the Parameter Reference Manual for details.
- HDOP (Horizontal Dilution Of Precision) - a measure of the strength of the figure used to compute the fix.
- Time to first fix, in seconds
- Longitude, as +/- dddmm.mmm; sign (only minuses are shown; positive East), degrees, minutes, and decimal minutes.
- Latitude, as +/- ddmm.mmm (only minuses are shown; positive North).
- Time, as hhmmss in UTC
- Date, as ddmmyy(after 2000)
- No-comm count: number of calls since last complete data transfer
- Calls made
- Dive number

Location obtained by the Iridium phone's geolocation property. This may be accurate to +/- 20km or more.

ver=66.04l,rev=1243M,frag=4,launch=110908,151311
Iridium bars: 5 geolocation: 1846.424805,12238.228516,031207,020210
Sun Dec 2 19:17:20 2007 [sg123] cmdfile/XMODEM: 128 Bytes, 17 BPS
Received cmdfile 17 bytes

Describes the transmission of the command file from the basestation to the Seaglide.

Sun Dec 2 19:17:49 2007 [sg123] sector number = 1, block length = 1024
Sun Dec 2 19:17:54 2007 [sg123] sector number = 2, block length = 1024
Sun Dec 2 19:18:00 2007 [sg123] sector number = 3, block length = 1024
Sun Dec 2 19:18:05 2007 [sg123] sector number = 4, block length = 1024
Sun Dec 2 19:18:07 2007 [sg123] received EOT and read timed out

These lines describe the glider sending a file to the basestation.

- End of transmission

Sun Dec 2 19:18:07 2007 [sg123] sector number = -10,block length = 1024

- Indicates end of file

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Sun Dec 2 19:18:07 2007 [sg123] done - sending ACK

Acknowledgement that file was sent

Sun Dec 2 19:18:07 2007 [sg123] sg0055lz.x00/XMODEM: 4096 Bytes, 178 BPS

The name of the file is printed after the glider has finished sending it

Sun Dec 2 19:18:07 2007 [sg123] Exiting (0)
Sun Dec 2 19:18:14 2007 [sg123] sector number = 1, block length = 1024
Sun Dec 2 19:18:19 2007 [sg123] sector number = 2, block length = 1024
Sun Dec 2 19:18:23 2007 [sg123] sector number = 3, block length = 1024
Sun Dec 2 19:18:28 2007 [sg123] sector number = 4, block length = 1024
Sun Dec 2 19:18:31 2007 [sg123] received EOT and read timed out
Sun Dec 2 19:18:31 2007 [sg123] sector number = -10, block length = 1024
Sun Dec 2 19:18:31 2007 [sg123] done - sending ACK
Sun Dec 2 19:18:31 2007 [sg123] sg0055dz.x00/XMODEM: 4096 Bytes, 189 BPS
Sun Dec 2 19:18:31 2007 [sg123] Exiting (0)
Sun Dec 2 19:18:38 2007 [sg123] sector number = 1, block length = 1024
Sun Dec 2 19:18:43 2007 [sg123] sector number = 2, block length = 1024
Sun Dec 2 19:18:49 2007 [sg123] timeout trying to read next sector
Sun Dec 2 19:18:50 2007 [sg123] finished waiting for next line - cnt = 999
Sun Dec 2 19:18:50 2007 [sg123] got 0x2d sector header
Sun Dec 2 19:18:53 2007 [sg123] finished waiting for next line - cnt = 746
Sun Dec 2 19:18:54 2007 [sg123] got 0x40 sector header
Sun Dec 2 19:18:57 2007 [sg123] finished waiting for next line - cnt = 787
Sun Dec 2 19:18:59 2007 [sg123] sector number = 3, block length = 128
Sun Dec 2 19:19:02 2007 [sg123] timeout trying to read next sector
Sun Dec 2 19:19:03 2007 [sg123] finished waiting for next line - cnt = 999
Sun Dec 2 19:19:04 2007 [sg123] got 0xe6 sector header
Sun Dec 2 19:19:06 2007 [sg123] finished waiting for next line - cnt = -1
Sun Dec 2 19:19:06 2007 [sg123] got 0xb7 sector header
Sun Dec 2 19:19:07 2007 [sg123] finished waiting for next line - cnt = 875
Sun Dec 2 19:19:08 2007 [sg123] sector number = 4, block length = 128
Sun Dec 2 19:19:10 2007 [sg123] sector number = 4, block length = 128
Sun Dec 2 19:19:10 2007 [sg123] received dup sector = 4
Sun Dec 2 19:19:12 2007 [sg123] timeout trying to read next sector
Sun Dec 2 19:19:13 2007 [sg123] finished waiting for next line - cnt = 999
Sun Dec 2 19:19:13 2007 [sg123] got 0xaf sector header
Sun Dec 2 19:19:15 2007 [sg123] finished waiting for next line - cnt = -1
Sun Dec 2 19:19:15 2007 [sg123] got 0x59 sector header
Sun Dec 2 19:19:17 2007 [sg123] finished waiting for next line - cnt = 543
Sun Dec 2 19:19:17 2007 [sg123] got 0x59 sector header
Sun Dec 2 19:19:21 2007 [sg123] finished waiting for next line - cnt = 130
Sun Dec 2 19:19:23 2007 [sg123] sector number = 6, block length = 128
Sun Dec 2 19:19:23 2007 [sg123] sync error in protocol

Errors in transmission are reported. If the Iridium connection drops, the communications session times out.

Duplicate and/or missing sector numbers indicate loss of synchronization between the Seaglider and the basestation. Errors can also be caused by dropped Iridium connections. The Seaglider will automatically call back and try sending data again until it succeeds or reaches the maximum number of calls (set by the parameter $CALL_TRIES).

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```
Sun Dec 2 19:19:23 2007 [sg123] sg0055dz.x01/XMODEM: got error
Renamed partial file sg0055dz.x01 to sg0055dz.x01.PARTIAL.1
Sun Dec 2 19:19:23 2007 [sg123] processed partial file sg0055dz.x01 (0x0)
Sun Dec 2 19:19:23 2007 [sg123] Exiting (128)
Disconnected at Sun Dec 2 19:19:39 PST 2007
```

In this case, the glider "realizes" that the basestation did not receive a complete file. The glider will automatically resend the file on the next call.

```
Connected at Sun Dec 2 19:21:39 PST 2007
159:0:2:0 GPS,031207,031455,1855.179,12237.359,41,1.3,41,-2.1
ver=66.03,rev=1243M,frag=4
Iridium bars: 5 geolocation: 1846.424805,12241.375977,031207,070746
Sun Dec 2 19:21:58 2007 [sg123] cmdfile/XMODEM: 128 Bytes, 14 BPS
Received cmdfile 17 bytes
Sun Dec 2 19:22:28 2007 [sg123] sector number = 1, block length = 1024
Sun Dec 2 19:22:33 2007 [sg123] sector number = 2, block length = 1024
Sun Dec 2 19:22:37 2007 [sg123] sector number = 3, block length = 1024
Sun Dec 2 19:22:42 2007 [sg123] sector number = 4, block length = 1024
Sun Dec 2 19:22:45 2007 [sg123] received EOT and read timed out
Sun Dec 2 19:22:45 2007 [sg123] sector number = -10, block length = 1024
Sun Dec 2 19:22:45 2007 [sg123] done - sending ACK
Sun Dec 2 19:22:45 2007 [sg123] sg0055dz.x01/XMODEM: 4096 Bytes, 186 BPS
Sun Dec 2 19:22:45 2007 [sg123] Exiting (0)
Sun Dec 2 19:22:53 2007 [sg123] sector number = 1, block length = 1024
Sun Dec 2 19:22:58 2007 [sg123] sector number = 2, block length = 1024
Sun Dec 2 19:23:03 2007 [sg123] sector number = 3, block length = 1024
Sun Dec 2 19:23:07 2007 [sg123] sector number = 4, block length = 1024
Sun Dec 2 19:23:10 2007 [sg123] received EOT and read timed out
Sun Dec 2 19:23:10 2007 [sg123] sector number = -10, block length = 1024
Sun Dec 2 19:23:10 2007 [sg123] done - sending ACK
Sun Dec 2 19:23:10 2007 [sg123] sg0055dz.x02/XMODEM: 4096 Bytes, 186 BPS
```

If no error is reported, but the basestation does not receive a complete file, the pilot can command the glider to resend the dive by using a Pdos command (see resend_dive in the Extended PicoDos Reference Manual).

The file was successfully resent.

2.2.2 SG Calib constants

(sg_calib_constants.m)

The "calib constants" file contains calibration information about each of the sensors on the Seaglider. This file is created by the pilot or operator, and exists only on the basestation. It does not have a counterpart on the Seaglider. Except for the compass, all of the sensors come calibrated to the Seaglider Fabrication Center.

Their calibration numbers can be found in the notebook delivered with the glider, and should be entered in this file. The compass values are recorded when the Seaglider is fully assembled, and the compass is calibrated in the presence of the batteries and other hardware. The values in this file should be checked, and changed if necessary, whenever new sensors are installed, batteries are changed, or other hardware alterations are made.

The calib_constants file is also used by various visualization tools (Matlab, GLMPC, etc.) to plot Seaglider data. Incorrect values in this file will result in incorrect scientific data in the plots.

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Example Calibration Constants file

```
% sg_calib_constants.m
% establishes glider calibration constants

id_str = '128'; Seaglider serial number

mission_title =' Port Susan Aug 15 2007'; pilot or operator specified
   calibcomm =  'SBEs/n0041,  calibration 25 April 2006';
                        Sensor serial number (found in SG notebook)
                Sea-Bird Electronics
t_g = 4.37369092e-03 ;
t_h = 6.48722213e-04 ;          SBE temperature sensor calibration coefficients
t_i = 2.63414771e-05 ;
t_j = 2.83524759e-06 ;
% Minimum and maximum frequencies (kHz) for reasonable
% oceanographic values of temperature from SBE calibration
% for C/T s/n 041
sbe_temp_freq_min = 3.214274; % kHz     From SBE sensor calibration. Basestation processing will reject
sbe_temp_freq_max = 6.081845; % kHz     observed temperature frequencies outside of this range.
c_g = -9.97922732e+00 ;
c_h = 1.12270684e+00 ;          SBE conductivity sensor calibration coefficients
c_i = -2.35632554e-03 ;
c_j = 2.37469252e-04 ;
% Minimum and maximum frequencies (kHz) for reasonable
% oceanographic values of conductivity SBE calibration
% for C/T s/n 041

sbe_cond_freq_min = 2.98792; % kHz     From SBE sensor calibration. Basestation processing will reject
sbe_cond_freq_max = 7.95840; % kHz     observed temperature frequencies outside of this range.
cpcor = -9.57e-08 ;
ctcor = 3.25e-06 ;

calibcomm_oxygen = '0106';

Soc = 2.1921e-04;
Boc = 0.0;
Foffset = -825.6362;
TCor = 0.0017;
PCor = 1.350e-04;

mass = 52.173; measured mass of glider

hd_a = 0.003836; lift
hd_b = 0.010078; drag                   Seaglider hydrodynamic parameters
hd_c = 9.8541e-6; induced drag (by lift)
```


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```
rho0 = 1027.5;
pitch_min_cnts = 426;
pitch_max_cnts = 3705;
roll_min_cnts = 157;
roll_max_cnts = 3897;
vbd_min_cnts = 550;
vbd_max_cnts = 3875;
vbd_cnts_per_cc = -4.0767;
volmax = 51344;
```

Greatest expected water density in area of operation

Software limits

Volume, in cc, the glider displaces when fully pumped; see the Seaglider Pilot's Guide for tank and ballasting information.

2.2.3 Pagers file

(.pagers)

The "dot pagers" file controls the automatic notification system. It allows any of three types of messages to be sent to any valid email address: gps, alerts, and recov (see below). This service is run by the data conversion script, which is invoked by a glider logout or disconnection. Lines beginning with a # are comment lines, and are ignored in processing.

```
# Joe Smith
#joe@gmail.com,gps,alerts,recov
jsmith@apl.washington.edu,recov
2065551234@messaging.sprintpcs.com,recov
# Jane Jones
jjones@apl.washington.edu,gps,alerts,recov
```

Joe Smith will receive emails to his APL account, and text messages to his Sprint phone, but will not receive messages to his gmail account.

- If the glider goes into recovery, send the most recent GPS position and the recov code.
- Send an alert when the basestation has a problem converting a file or files.
- After every dive, send the most recent GPS position and, if the glider is in recovery, the recov code.

```
#2063335555@vtext.com,gps,alerts,recov
#2061239999@vtext.com,gps,alerts
#Iridium Phone
#881645559999@msg.iridium.com,gps
```

2.2.4 Basestation log

```
baselog_000000999999,baselog.log)
```

- Time; hhmmss (time zone as kept on basestation)
- Date; ddmmyy

The baselog_ file is produced by the basestation, and logs the output from the scripts that perform the data conversion and notification functions of the basestation. It is written during each invocation. This file is the first place to look when debugging problems with the data conversion. If the basestation cannot process a file, it sends an alert to any contact listed in the .pagers file.

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The baselog.log is an accumulation of all of the basestation conversions reported in the baselog_ files, without the timestamps.

2.3 On-board glider information

This section includes files that are stored on the Seaglider. Most of the information in these files is used by the glider in calculations regarding navigation and energy usage.

2.3.1 Processed files cache

(processed_files.cache)

This file contains the dives that have been processed and the time of processing. To force a file to be re-processed, delete the corresponding line from this file. Comment lines are indicated by a #.

Example processed_files.cache

Written 14:54:28 23 Feb 2008 UTC

st0007pz.000, 19:05:58 21 Feb 2008 UTC

sg0000kl, 14:54:28 23 Feb 2008 UTC

st0007du, 19:05:58 21 Feb 2008 UTC

st0007lu, 19:05:58 21 Feb 2008 UTC

st0009du, 19:40:22 21 Feb 2008 UTC

st0009kz, 19:16:44 21 Feb 2008 UTC

st0009lu, 19:37:51 21 Feb 2008 UTC

st0010du, 20:21:33 21 Feb 2008 UTC

st0010kz, 20:15:35 21 Feb 2008 UTC

st0010lu, 20:15:34 21 Feb 2008 UTC

st0011du, 14:54:28 23 Feb 2008 UTC

st0011kz, 14:30:35 23 Feb 2008 UTC

st0011lu, 14:30:35 23 Feb 2008 UTC

2.3.2 Bathymap

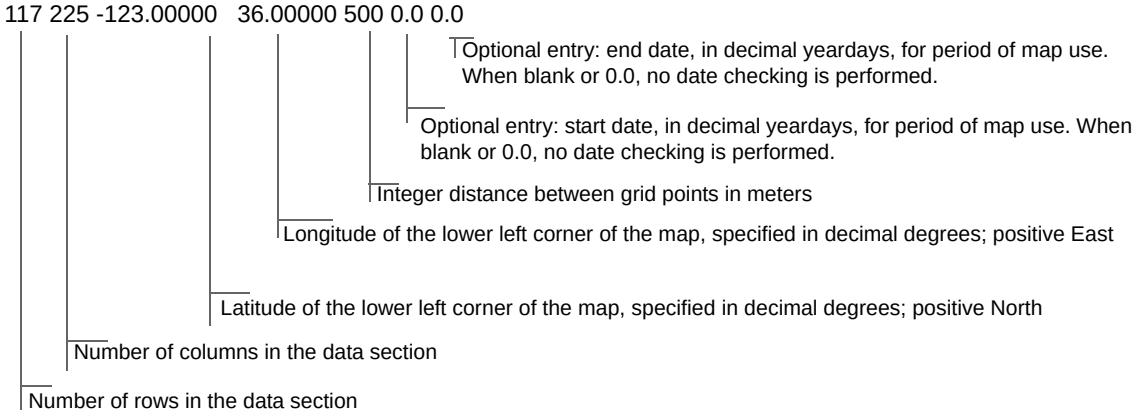
When the bathymetry map-reading function of the glider is enabled, this file contains the map. It is usually uploaded to the Seaglider system's compact flash before deployment, but may be uploaded in the field if necessary.

Map files provide the glider with geographic (and sometimes temporal) environmental information. A bathymetry map provides the glider with bathymetry data about a given region of the ocean. The glider may carry up to 999 bathymetry maps (the files are named bathymap.000), but in practice far fewer are on board. These maps are not required for gliders to fly. For more details on how bathymetry maps are used, see "Bathymetric files" on page 115.

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In addition to bathymetry maps, the glider can carry ice maps which indicate a spatially and temporally varying climatology of ice cover. The glider can use this information to make decisions about surfacing.

Both kinds of maps contain a fixed-size header, followed by a variable-length data section. The header is defined as follows:


117 225 -123.00000 36.00000 500 0.0 0.0
Optional entry: end date, in decimal yeardays, for period of map use. When blank or 0.0, no date checking is performed.
Optional entry: start date, in decimal yeardays, for period of map use. When blank or 0.0, no date checking is performed.
Integer distance between grid points in meters
Longitude of the lower left corner of the map, specified in decimal degrees; positive East
Latitude of the lower left corner of the map, specified in decimal degrees; positive North
Number of columns in the data section
Number of rows in the data section

For a bathymetry map, the data section contains the depth of the bottom at each grid point, expressed in integer meters. The data is stored in column major order.

For an ice map the data section contains ice condition values for the time period between the start and end dates at each grid point. Ice condition values are stored as 2-bit integers packed sequentially together into sixteen equal length periods spanning the dates between start date and end date. Valid condition codes are: 0 = always surface, 1 = possibly ice, 2 = probably ice, 3 = always ice. As an example, for a start date = 0.0 and end date = 365.0, the lowest two bits of the value at any grid point encode the ice condition for the first 23 days of the year. Bits 2 and 3 cover the condition for the next 23 days, etc.

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2.3.3 Battery file

(BATTERY)

The Battery file is used by the glider to keep track of power consumption throughout the time the glider is using the battery pack. The Battery File is not intended to be edited by the user.

Pitch_motor 3041.069

Amp seconds drawn by this device since the battery pack power tracking was initiated

See $DEVICES and $SENSORS in the Log File section of this document.

Roll_motor 990.029
VBD_pump_during_apogee 216074.641
VBD_pump_during_surface 82015.531
VBD_valve 0.000
Iridium_during_init 17540.021
Iridium_during_connect 9597.448
Iridium_during_xfer 48699.711
Transponder_ping 873.774
Mmodem_TX 0.000
Mmodem_RX 0.000
GPS 5227.668
TT8 11375.065
LPSleep 3565.161
TT8_Active 9204.906
TT8_Sampling 30932.490
TT8_CF8 25142.061
TT8_Kalman 2861.964
Analog_circuits 10045.106
GPS_charging 0.000
Compass 5552.722
RAFOS 0.000
Transponder 126.060
SBE_CT 5738.196
SBE_O2 4966.481
WL_BB2F 59876.422

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2.3.4 Compass Calibration file

(TCM2MAT).123

Seaglider serial number

The compass is calibrated in the assembled glider, to account for effects of the metal on the compass readings. This file is stored on the glider by the assembler, and is not intended to be edited by the user.

Example Compass Calibration file

tcm2mat.sparton_SN100.sg123.080807

Date of last calibration (ddmmyy)

Seaglider serial number

compass type and serial number

-0.0184 0.8424 0.1660 0.0466
0.0133 0.9603 0.0447 -0.0185
0.0984 -0.0018 0.0018 0.0010 0.1054 -0.0004 -0.0008 0.0012 0.1040
53.9472 -17.3493 5.8241 compass calibration values

2.3.5 Capvec file

The Capvec file is parsed by the glider and updates one or more elements of the Capture Vector. Normally, this file is not used except for glider provisioning. See the capvec and parse_capvecfile commands in Extended PicoDOS Reference Manual for details on updating the Capture Vector, and the section Capture files in the Seaglider Pilot's Guide for details how and when to use capture files.

The Capvec file is a line oriented format. Lines may be comment lines, in which case the first character must be a /. All other lines are updates to the Capture Vector and are documented under the capvec command in the Extended PicoDOS Reference Manual.

2.4 Command and control files

These files are created by the pilot to control the Seaglider mission characteristics. Formats are given here, but usage of these files is discussed in the Seaglider Pilot's Guide.

2.4.1 Targets file

(targets)

The Pilot creates the targets file. One target is listed per line, and the target name must be listed first. The order of the other fields does not matter. Comments can be included, preceded by a %.

SEVEN	lat=4807.0	lon=-12223.0	radius=200	goto=SIX
SIX	lat=4806.0	lon=-12222.0	radius=200	goto=FIVE
FIVE	lat=4805.0	lon=-12221.0	radius=200	goto=EIGHT
FOUR	lat=4804.0	lon=-12220.0	radius=200	goto=EIGHT

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KAYAKPT	lat=4808.0	lon=-12223.0	radius=100	goto=KAYAKPT
Target name - this can be any string of numbers and/or letters, without whitespace.	Latitude, in +/- ddmm.m; positive North	Longitude, in +/- dddmm.m; positive East	Radius, in meters, within which the Seaglider determines it has reached the target.	Next target - this target name must be specified in the Target column.

Above is a typical version 66 targets file. It has all the fields necessary to direct the Seaglider to targets. There are also four optional fields, which can be added as columns in the targets file:

escape=KAYAKPT	depth=100	finish=90	timeout=3.0
The escape_target specifies what target to move to if the glider has been unable to navigate for a specified length of time (e.g. if it is stuck under the ice). The escape_target must be a valid named target in the file and can vary for each named target. One possible future use is to have the standard targets along a cyclical survey route all point to a single escape target that then points (through next_target) to a series of targets that define an entire route to a convenient recovery location.	Specifying a value for depth on a target means that target can be achieved by crossing a bathymetric contour. If the value is positive the target is achieved when crossing that contour from deep to shallow. When negative, target achievement is defined by moving across that contour from shallow to deep. The glider measures its depth for comparison against the target depth either by altimetry or via a $T_NO_W timeout during the dive phase.	Finish specifies a direction (degrees), and establishes a finish line through the target, perpendicular to the direction specified. The target is considered achieved when the difference between the bearing to the target and the finish direction is greater than 90 (or less than -90) degrees. Example 1: finish direction of 90 specifies a north-south finish line drawn through the target; the target is achieved when the glider is east of the line. Example 2: finish direction of 180 specifies an east-west finish line; target is achieved when glider is south of the line. A value of -1 or no specification of finish means that no finish line will be tested.	Timeout specifies a length of time (in days) that the glider should try to achieve this target. If the timeout is exceeded the glider will proceed to the target named by goto. If timeout is not specified or is given as zero then the glider will try to achieve the target with no time limit.

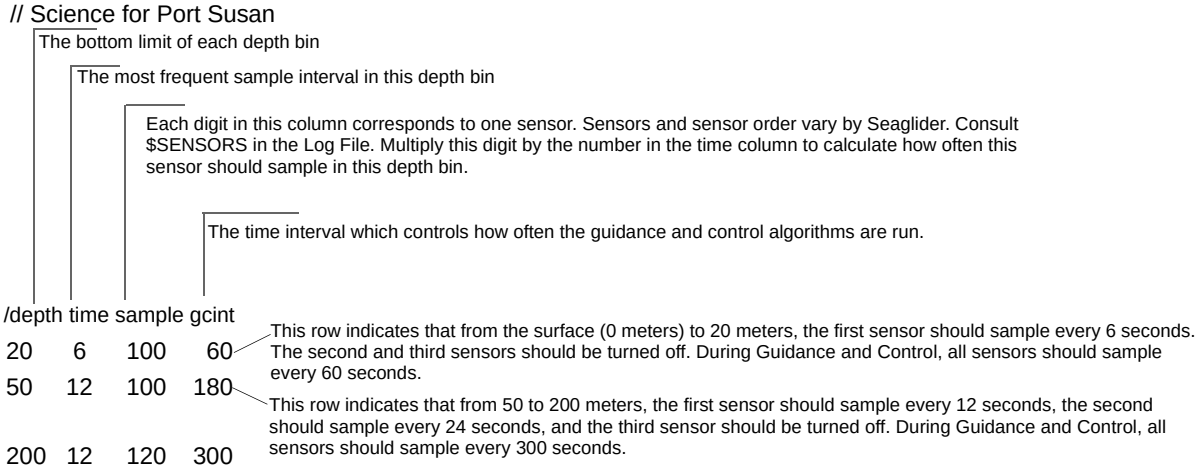
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2.4.2 Science file

(science)

This file, created by the pilot, contains instructions for the Seaglider about when to sample with the scientific instruments. Comment lines are indicated by a/, and columns are separated by tabs.

Example Science file


// Science for Port Susan
The bottom limit of each depth bin
The most frequent sample interval in this depth bin
Each digit in this column corresponds to one sensor. Sensors and sensor order vary by Seaglider. Consult $SENSORS in the Log File. Multiply this digit by the number in the time column to calculate how often this sensor should sample in this depth bin.
The time interval which controls how often the guidance and control algorithms are run.
/depth time sample gcint
20 6 100 60
50 12 100 180
200 12 120 300
This row indicates that from the surface (0 meters) to 20 meters, the first sensor should sample every 6 seconds. The second and third sensors should be turned off. During Guidance and Control, all sensors should sample every 60 seconds.
This row indicates that from 50 to 200 meters, the first sensor should sample every 12 seconds, the second should sample every 24 seconds, and the third sensor should be turned off. During Guidance and Control, all sensors should sample every 300 seconds.

2.4.3 Command file

(cmdfile)

Refer to the Pilot's Guide for more information on the Command File.

2.4.4 Pdos Commands file

(pdoscmds.bat)

The file pdoscmds.bat is created by the pilot, and uploaded to the Seaglider. It is used to deal with the Seaglider software. See the Extended PicoDOS Reference Manual for information.

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APPENDIX C

Extended PicoDOS® Reference Manual, v66.07

This appendix contains the *Extended PicoDOS Reference Manual*, v66.07, revised December 2009.

You can use the copy command in addition to the commands in this reference:

```
copy <source filename> <destination filename>
```

Description: This command copies a source file to a destination specified.

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Extended PicoDOS® Reference Manual

SCHOOL OF OCEANOGRAPHY and APPLIED PHYSICS LABORATORY
UNIVERSITY OF WASHINGTON v66.07
December 2009

Chapter 1
Introduction and Conventions

1.1 Introduction

This manual is a reference to extensions to the PicoDOS® operating system command set implemented in the Seaglider operating code. PicoDOS is a registered trademark of Persistor Instruments, Inc., Bourne MA, USA.

The version number of this document coincides with the version of the main Seaglider operating code in which these extensions exist.

These extensions either make new functions available from the PicoDOS prompt, or extend the capabilities of existing functions. Commands are only available through the Seaglider operating code, which intercepts and interprets the commands, passing them to PicoDOS as appropriate. While in this mode, the Seaglider code passes any command not explicitly recognized as an extended PicoDOS command on to PicoDOS itself for execution. Limited error reporting exists in this case.

The extensions are accessible at the PicoDOS prompt available from the main menu when connected directly to a Seaglider (exceptions as noted below), or by uploading the **pdoscmds.bat** file when the Seaglider is operating autonomously. In the former case, the Seaglider code displays a standard PicoDOS prompt (picoDOS>) with an extra ' >', as follows.

```
picoDOS>>
```

In the latter case, results of the extended PicoDOS commands are captured to a file and transferred to the Seaglider basestation (in compressed form, named **sg0055pz.000**, using "0055" as a placeholder for dive number, and "000" for increment number) following execution of the commands. The basestation renames this file per the **p1230055.000.pdos** convention.

The **pdoscmds.bat** file is a plain text sequence of extended PicoDOS commands, one per line. Lines that begin with a forward slash ('/') are interpreted as comments and are ignored.

Chapter 2 is a list of the extended PicoDOS commands, grouped by functional area. Chapter 3 is an alphabetical-order reference for each command. Note that standard PicoDOS commands are not documented here.

1.2 Document Conventions

Extended PicoDOS commands are shown in ***bold italic*** type below. Options and arguments are shown on the same line. Exposition follows in plain type. File names are given in **lower-case bold** font. Click

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on the name of a command to jump to its description. Use the "Back" button to return to the previous location.

1.3 PicoDOS

PicoDos® is Persistor Instrument's DOS-like operating system for the CF8/TT8 combination used on Seaglider. It provides access to the DOS FAT file system on the Compact Flash, as well as some simple file manipulation utilities. The TOM8 and PicoDOS commands are documented in the Pico-DOS User's Guide of November, 2000 (which is incorporated into this document by reference). The extensions below provide additional functionality, either to extend PicoDOS generally or to provide Seaglider-specific functions.

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Chapter 2.

List of Extended PicoDOS® Commands

Help and exit

?
??
pdos
tom8
quit

File manipulation and data

bathycat
<filespec>+ [[> | >>] <outfile>]
[del | rm] [/v] <filespec>+
gunzip <zipped_file> <file> gzip <file> <zipped_file>
md5 [<signature>] <file>
[ren | rename] <file1> <file2>
resend_dive [/l| /d | /c | /t] <dive> <fragment>
science
split <filename>
strip1a <filename> [<size>]
sumasc <file>
tar [c | x] <file> <filespec>
[xs | put | xr | get] <filespec>+

Control

$PARAM,value
clearnv <passphrase>
dumpnv
readnv <varname>
reboot <run_file> <arguments>
[target | targets] [<new_target> [<radius>]]
writenv <varname> <value>

Diagnostics

capvec [<service> <level> <dest>]
flash_errors
menu <menuspec> [<arguments>]
parse_capvecfile <file>
usage
ver

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Chapter 3

Extended PicoDOS® Command Reference

bathy

Causes the on-board bathymetry files to be re-read, checked, and, if appropriate, loaded into memory. Useful for checking the integrity of the bathymetry files on the compact flash.

capvec [<service> <level> <dest>]

Without arguments, displays the current capture vector. The capture vector describes the capture output level and destination for each of the Seaglider's hardware and software services. Every output line in the Seaglider source code that is capturable is assigned a service and an output level (verbosity). The capture vector controls where the output is routed to and what the output level (verbosity) is for each service. With arguments, sets the capture vector for a specific service (table 2.1) to the specified level (table 2.2) and destination (table 2.3).

Table C-1. Available services for capturing

Service	Description
HPITCH	Pitch motor
HROLL	Roll motor
HVBD	VBD Pump and Valve
HPHONE	Modem hardware
HGPS	GPS receiver
HTT8	TT8 Computer
HCF8	Flash hardware
HANALOG	Analog circuits and control
HCOMPASS	Compass hardware
HRAFOS	RAFOS hardware
HSBECT	Seabird CT sensor
HSBEO2	Seabird O2 sensor
HWLBB2F	Wetlabs sensor
HOPTODE	Optode O2 sensor
HBATT	Battery hardware and charging
HPRES	Pressure Sensor
HXPDR	Transponder hardware
SPOWER	Software managing power
SBATHY	Software managing bathymetry
SNAV	Software managing navigation (primarily targets)
SKALMAN	Software kalman filter
SMOTOR	Software controlling all motor movements (primarily GC nterrupt handler)

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Table C-1. Available services for capturing (Continued)

Service	Description
SSENSOR	Software controlling all sensors (primarily data sampling)
SDIVE	Software controlling dive and flight
SSURF	Software controlling surface activities
SEPDOS	Extended PicoDOS support
SSYS	Software utilities and infrastructure
SUSR	Software dealing primarily with human console interaction (primarily tests and menus)
SGLMALLOC	Seaglider's heap implementation

Table C-2. Levels at which output can be captured for a given service

Output Level	Description
CRITICAL	Only trigger output thaty is critical in nature - usually associated with an extreme hardware problem (such as motor errors) or a critical software problem - such as buffer or heap overrun.
NORMAL	The vast majority of Seaglider output falls into this category currently.
DEBUG	Extended diagnostics. This output can be quite volumnious and it is recommended that this only be set on specific services when it is known that some needed output will be captured. Most services do not have output in this level currently, but work is ongoing to add extended dignostics under this output level.

Table C-3. Available destinations for capture output of any service

Destination	Description
NONE	Do no output for this service.
PRINT	Send output only to the operator console.
FILE	Send output only to the **capture file**.
BOTH	Send output to both the operator console and to the **capture file**.

Note that a higher level of output also implies the lower levels. For example, setting a services output to **NORMAL** implies that **CRITICAL** output will also be triggered.

Example: *capvec HVBD DEBUG PRINT*

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Sets the hardware VBD service output to debug level (most verbose) and routes the output for that service to the operators console only.

By default, the Seaglider software sets the output levels to **NORMAL** and output destination to **BOTH** for all services. As a side effect of this change, the **capture file** is almost always being filled with output.

cat <filespec>+ [[> | > >]<outfile>]
Concatenates files in the same general way as the standard Unix cat command. Admits use of wild-cards (*) in the file specification.

Example: *cat chunk.U30 chunk.U31 > > chunk.GZ*

clearnv <passphrase>
Clears contents of non-volatile RAM utility storage. The passphrase must exactly match one of the strings hard-coded in epdos.c: I_really_mean_it! clears all utility storage (including password and telephone numbers), I_mean_it! only clears latched target and flight state information.

[del | rm] [/v] <filespec>+
Extends the standard delete (del) command by admitting use of wildcards (*) in the file specification.

Example: *del SG01*LZ.A*

dumpnv
Dumps contents of non-volatile RAM.

flash_errors
Reports CF8 file open, write and close retries and errors.

gunzip <zipped_file> <file>
Uncompresses file compressed with gzip.

Example: *gunzip chunk.GZ MAIN.RUN*

gzip <file> <zipped_file>
Compresses file with gzip.

Example: *gzip MAIN.RUN MAIN.GZ*

lsleep <seconds>
Pause execution in low power sleep for up to 60 seconds.

md5 [<signature>] <file>
Generates 128-bit md5 hashes of the specified file. If a signature (hash) is specified, md5 compares the specified signature (hash) with the one it generates for the file and generates an error if they are not identical (in the character-by-character sense). Used to verify the integrity of files uploaded to the Seaglider. In particular, md5 is the verification part of the protocol used to upload, verify and reboot new executable code on the Seaglider.

Example: *md5 082ab2b60d626181e73b17429c55dd8f chunk.GZ*

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menu <menuspec> [<arguments>]

Execute commands from the Seaglider code menu tree, by specifying the absolute menu path to the command and any required arguments. The menu is specified by menu names, separated by forward slashes, '/'. The arguments are specified in a whitespace-separated list: arg1=val1 arg2=val2 ... .

Example: *menu /hw/ct*

$PARAM,value

Changes the specified parameter to the specified value. Parameters are specified by three-digit numbers (*nnn*), and are in lineal order as they appear in the Seaglider menus (or in the code source file *parms.h*).

Example: *$T_DIVE,330*

parse_capvecfile <file>

Parses a capture vector file and updates the capture vector. This command is normally used during glider provisioning or testing - the preferred way to set the capture vector is through the capvec command.

Example: *parse_capvecfile capvec.new*

pdos

Exits the Seaglider code to native picoDOS on the TT8/CF8.

quit

Exits the Seaglider extended picoDOS mode and returns to the Seaglider main menu.

readnv <varname>

Read the value of the specified variable, where the variable is one of the following: *target_name, password, selftest_count, boot_count, last_known_lon, last_known_lat, last_last_fix_time, magvar, fly_escape_route, fly_safe_depth, device0, device1, device2, device3, telnum*, or *altnum*.

reboot <run_file>

Reboots the Seaglider using the specified file name as the executable file. Note that the .run suffix is not used in this command. It is important to verify that the file that is the target executable is not corrupted. A way to prevent unrecoverable hangs is to never rename new unproven executables **main.run**. Name them **mainnew.run**, for example, and issue the ***reboot*** command as ***reboot mainnew***. If the Seaglider hangs during the reboot, the watchdog timer should initiate another reboot, but to the executable code called *main*, which presumably was running when the ***reboot*** command was issued. This is a fallback safety feature and should be noted.

Example: *reboot REVA*

[ren | rename] <file1> <file2>

Rename command which calls the CF8 rename command directly, and is aliased to work with either ***ren*** or ***rename***.

Example: *ren REVA.RUN MAIN.RUN*

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resend_dive [/l | /d | /c | /t] <dive> <fragment>

The mechanism by which the pilot can ask the Seaglider to resend individual pieces of previous log (/l), data (/d), capture (/c) or tar (/t) files. This is used to recover missing pieces of data, which are most often caused by protocol confusion between the Seaglider and the basestation (on whether or not a particular data piece was successfully transferred). The data are specified by type, dive number, and fragment number (the third 4kB piece of dive 123's data file would be specified "/d 123 2" (data piece counter starts at 0). Leading zeros on the fragment number are optional.

Example: *resend_dive /d 289 1*

science

Parses the on-board **science file**. Used mainly in the laboratory or test tank to establish sampling intervals for testing.

sleep <seconds>

Pause execution for up to 60 seconds.

split <file>

Splits files into pieces of size **$N_FILEKB** (kBytes).

Example: *split sg0115dz.r*

strip1a <file>[<size>]

Strips trailing XMODEM padding characters ('1a') off the end of a file, optionally to a specified size (in bytes).

Example: *strip1a chunk.U31 1898*

sumasc <file>

Sums succeeding lines of data file to recreate original observed values. This is the inverse of the simple successive difference compression scheme used for glider data files.

tar [c | x] <tarfile> <filespec>+

Implementation of standard Unix-style tar (tape archive) utility. Admits wild-card (*) expressions.

Example: *tar c data.tar SG01*DZ.A*

[target | targets] [<new_target> [<radius>]]

The mechanism by which the pilot can change the current Seaglider target and the target radius from among the targets listed in the current **targets file** on the Seaglider. The **new_target** must be in the list of targets in the **targets file** on the Seaglider flash. The radius is in meters.

Example: target NE_CORNER
Example: target SW_CORNER 1852

tom8

Exits the Seaglider main program and native picoDOS to the TT8 monitor program, TOM8. PicoDOS is started by issuing the command 'go 2bcf8' at the TOM8 prompt.

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usage

Provides a summary of disk usage on the compact flash.

ver

Provides versioning and configuration information for software and hardware installed (and running) on the Seaglider.

[xs | put | xr | get] <file1> <file2>

XMODEM protocol file transfer commands (issued from the glider).

Example: xr chunk.U30

Example: xs sg0150DZ.A

File names for these commands must be specified in the dos 8.3 file name specification. If a file name does not conform to these specifications and error will be returned that the file name is too long.

writenv <varname> <value>

Write specified value of specified variable to non-volatile RAM (NVRAM) utility storage. Variables stored in NVRAM are *target_name, password, selftest_count, boot_count, last_known_lon, last_known_lat, last_last_fix_time, magvar, fly_escape_route, fly_safe_depth, device0, device1, device2, device3, telnum*, and *altnum*.

?

Top-level help command, which only displays methods of exiting the Seaglider code's PicoDOS mode, and documents the ***??*** command.

??

Extensive help command, which displays methods of exiting the Seaglider code's PicoDOS mode, lists the available extended PicoDOS commands, and gives usage hints.

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APPENDIX D

Dive Data Visualization Software

Introduction

This Appendix describes how to execute the software that analyzes dive data acquired from the sensors installed on a Seaglider; also to indicate to the user the basic description of each plot displayed when the visualization scripts are run.

Acronyms, abbreviations, and definitions

Term	Definition
CT	Conductivity, Temperature, Depth sensor
GPCTD	Glider Payload Conductivity, Temperature, Depth sensor
PAR	Photosynthetically Active Radiation
GUI	Graphical User Interface
UI	User Interface
IDE	Integrated Development Environment

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Required tools

Software

- MATLAB 2010a (Other versions may work but are not supported or recommended)
- iRobot Seaglider Dive Data Analysis Software with Seawater Library 1.2d (visualization software)

Hardware

- Any computer or portable device capable of running MATLAB2010a and displaying plots.

Installation and configuration

MATLAB 2010a

Install MATLAB 2010a per the instructions that are provided with the MATLAB 2010a software.

iRobot Dive Data Analysis software (visualization software)

The Dive Data Analysis software comes packaged in a compressed archive file (*.zip). The contents must be extracted to your computer in order to use the software.

1. Create a folder on your root drive and name it, **DivePlot**.
2. Copy the visualization files supplied under the “Matlab Scripts” folder on your CD (or via FTP site) into the folder that you created in step 1.

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Using the dive plot analysis software

Run the MATLAB application

Per the instructions provided by MATLAB 2010a, start the MATLAB software. When the MATLAB Integrated Development Environment (IDE) appears on your computer monitor, it will look very similar to Figure D-1.

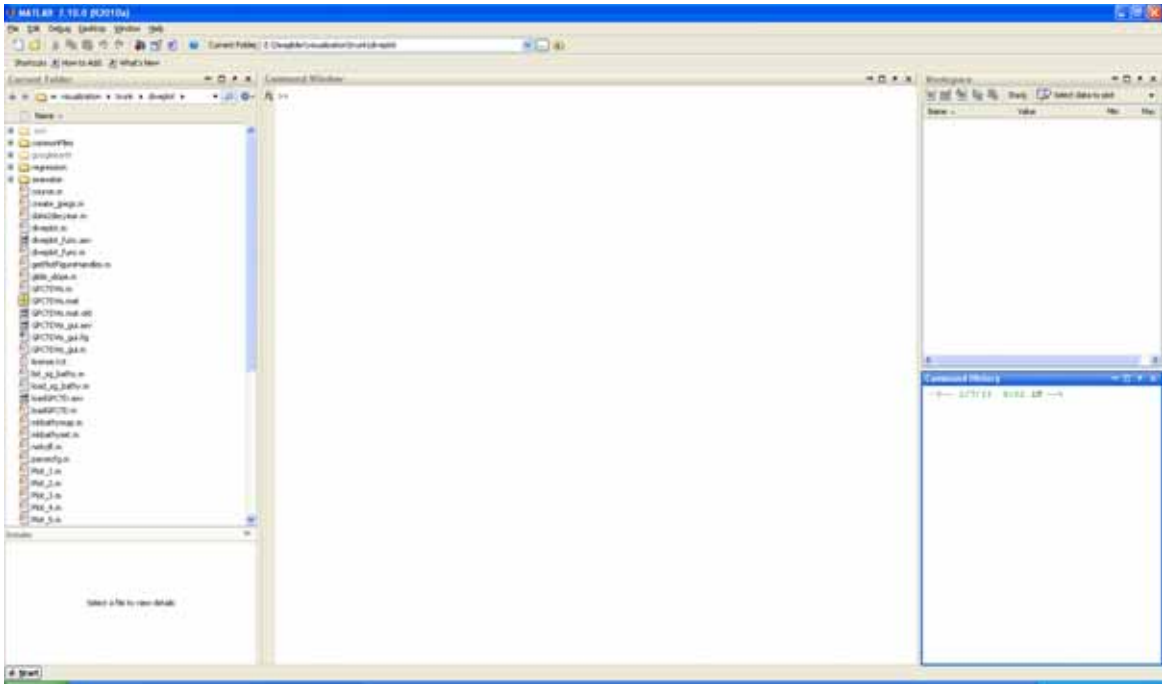


Figure D-1. Example of MATLAB Integrated Development Environment

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Set current folder

Once the MATLAB IDE is displayed on your computer monitor, the *current folder* must be set to the folder created called **Dive Plot** (or alternate name given above) containing the visualization software (Figure D-2).

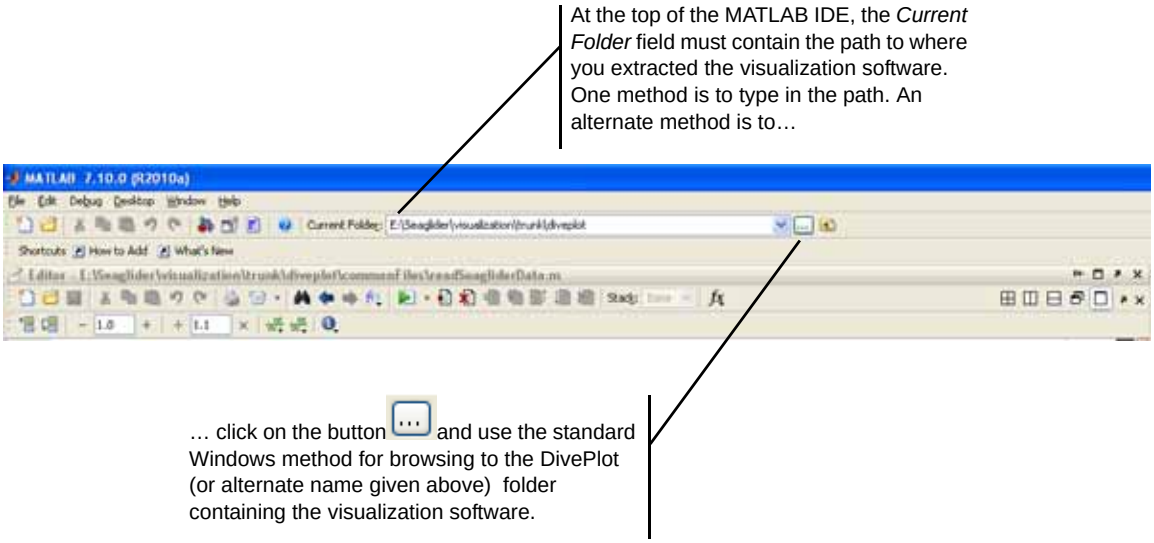
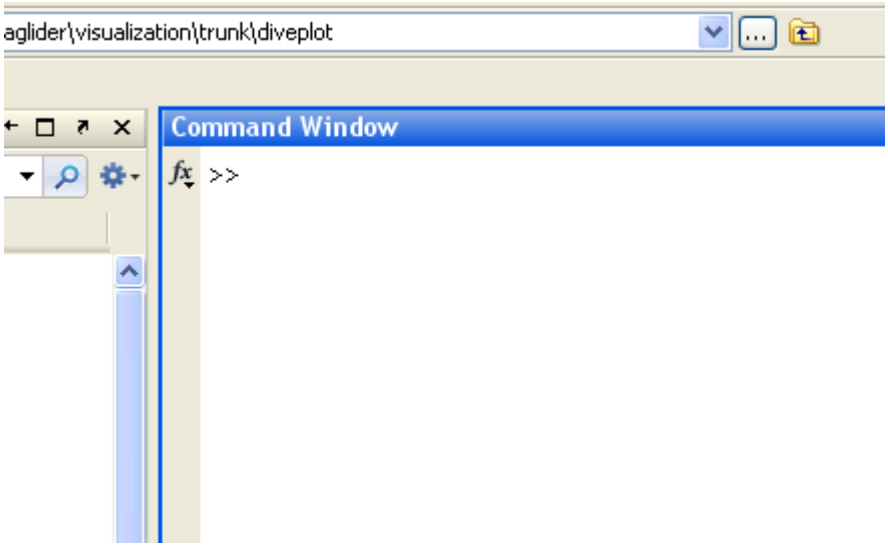

At the top of the MATLAB IDE, the *Current Folder* field must contain the path to where you extracted the visualization software. One method is to type in the path. An alternate method is to…
… click on the button … and use the standard Windows method for browsing to the DivePlot (or alternate name given above) folder containing the visualization software.

Figure D-2. Current folder set to Dive Plot folder

Loading the dive plot GUI

The MATLAB IDE contains a window titled, *Command Window.* Within the *Command Window* is a command prompt, >>. Refer to the following diagram to familiarize yourself with this window which will be used in the steps that follow.



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1. Move the mouse cursor to the right of the command prompt and click and release the left mouse button. You should see a blinking cursor – typically a vertical line or bar – next to the command prompt.
2. Type the following command at the command prompt: **run GPCTDVis_gui**



Figure D-3. Type command

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3. Press the **Enter** key on your keyboard.

   In several seconds you will see the Dive Data Analysis graphical user interface (GUI) appear. If this is the first time running the visualization software on the computer, the GUI will look like Figure D-4.

   Annotate Plot feature

   When the annotate plot box is checked, labels will be placed on the lines of the Vertical Velocity Plot (Plot #7) and on the lines of Vehicle Attitude Plot (Plot #1). These labels allow a Seaglider pilot to more easily identify the definitions of these plotted lines.

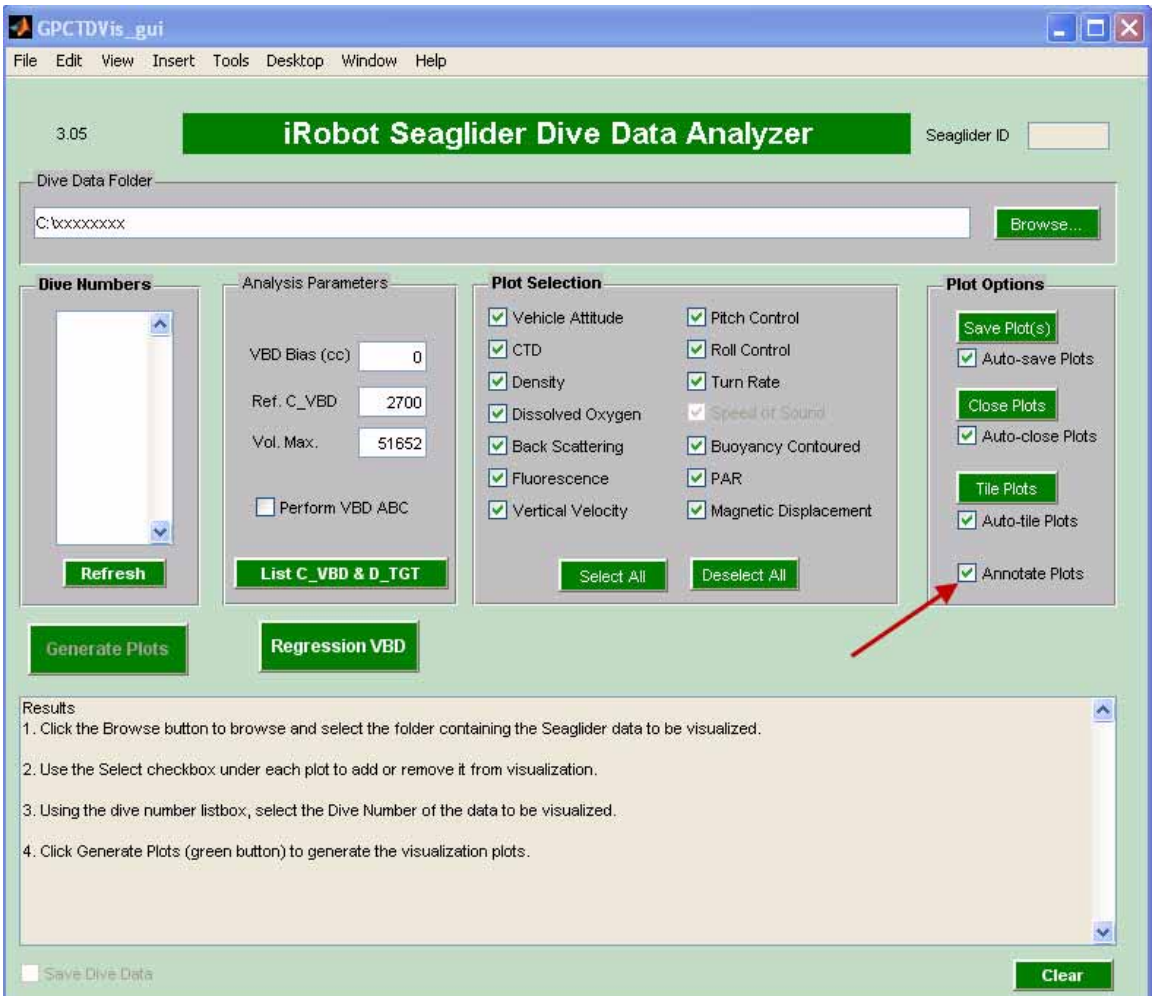


Figure D-4. Initial view of Dive Data Analysis graphical user interface

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Also when running for the first time, a notification stating the folder specified does not have the data required to run software. This is because the path that appears in the *Dive Data Folder* field upon start-tup of GUI is an invalid path and meant to be changed. Simply close this window by selecting OK and begin to browse to the appropriate **DivePlot** (or alternate name given above) folder (Figure D-5).

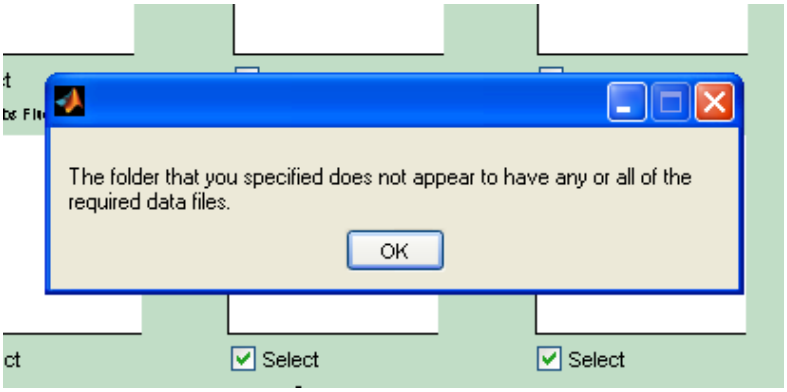


Figure D-5. Initial invalid path notification

Analyzing dive data

Specifying the dive data folder

Analyzing dive data begins with selecting the **DivePlot** folder that contains the mission dive data. Typically you will want to have the data on your local computer so that the analysis is performed quickly.

Specifying the data folder in the Dive Data Analysis GUI is similar to selecting the Current Folder in the MATLAB IDE as described in section "Set current folder" on page 246. You can either type the pathname into the *Dive Data Folder* field or click on the **Browse** button and use the standard Windows method of browsing to a folder (Figure D-6).

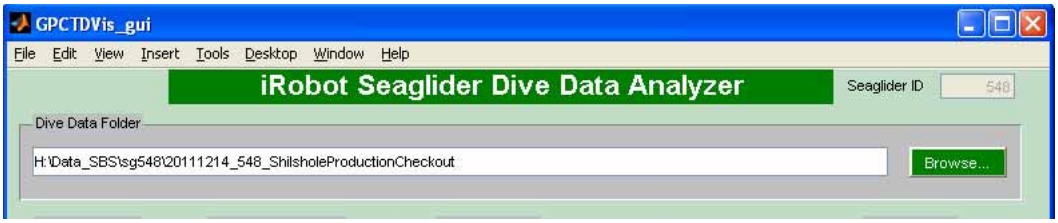


Figure D-6. Specify the data folder

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Selecting dive data for analysis

The Dive Data Analysis GUI has a field titled, *Dive Numbers* (Figure D-7). Once the folder containing dive data has been selected, the *Dive Numbers* field is populated with the available dives. This is a typical Windows type field where you use the scrollbar to scroll up or down the list to the dive number to be analyzed, and then click on the dive number in the field to select the dive for analysis.

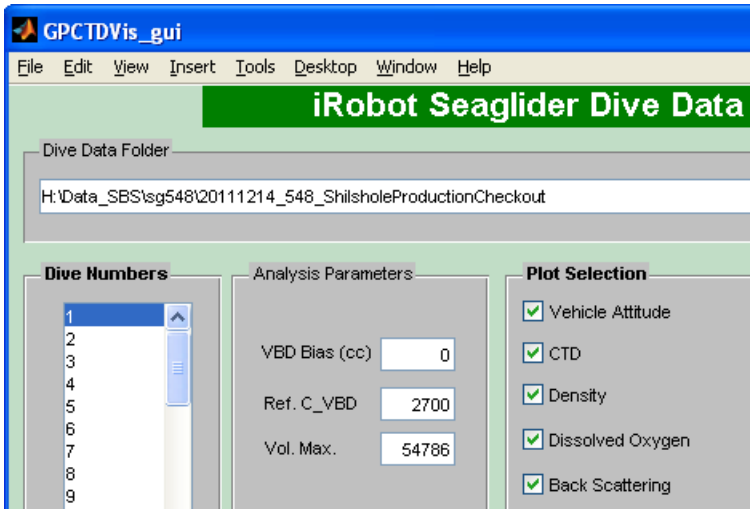


Figure D-7. Select dive data for analysis

Performing the analysis

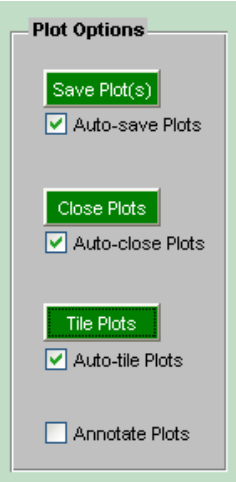
The Dive Data GUI provides the capability to customize the actions of the software when the data analysis is performed. These options will be discussed in more detail in subsequent sections of this document. For now, we will use the default values provided by the software.

Performing the analysis of the dive data for the *Dive Number* selected is accomplished by simply clicking the **Generate Plots** button on the Dive Data GUI. Upon clicking the button, the software will begin analyzing the data and generating the graphs to visualize the data for analysis.

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Auto-Save, Auto-Close, and Auto-Tile Plots

The following section of the Seaglider Dive Data GUI allows you to perform several actions once you begin to generate plots.



Auto-save plots creates a folder containing all visualization plots, in jpeg format, for the specified dive number.

If the Auto-save Plots box is checked and you then click the **Generate Plots** button, a folder is automatically placed within the **DivePlot** folder where all mission dive data has been stored containing all selected plots.

The folder is titled *pxxxyyyy_DivePlots*; where xxx is the Seaglider serial number and yyyy is the dive number (e.g., p5050002_DivePlots). If the box was not checked when the **Generate Plots** button is selected, the plots can still be saved after they are generated by selecting **Save Plot(s)** button.

The *Auto-close plot* automatically closes any open plots. The **Close Plots** button can be clicked to close plots, or if the *Auto-close Plots* box is checked as in example above, the plots will also close if another *Dive Number* is plotted using the **Generate Plots** button.

Auto-tile Plots aids in organizing visualization plots on the computer screen. If the Auto-tile Plots box is checked, and you then click the **Generate Plots** button, the plots are automatically organized in a window pane style on the screen. If the *Auto-tile Plots* box is not checked when the **Generate Plots** button is selected, the plots are stacked one on top of the other, with plot 1 being first, but can still be organized after generation by selecting **Tile Plots**. Figure D-8 shows an example of the *Auto-tile Plot* function.

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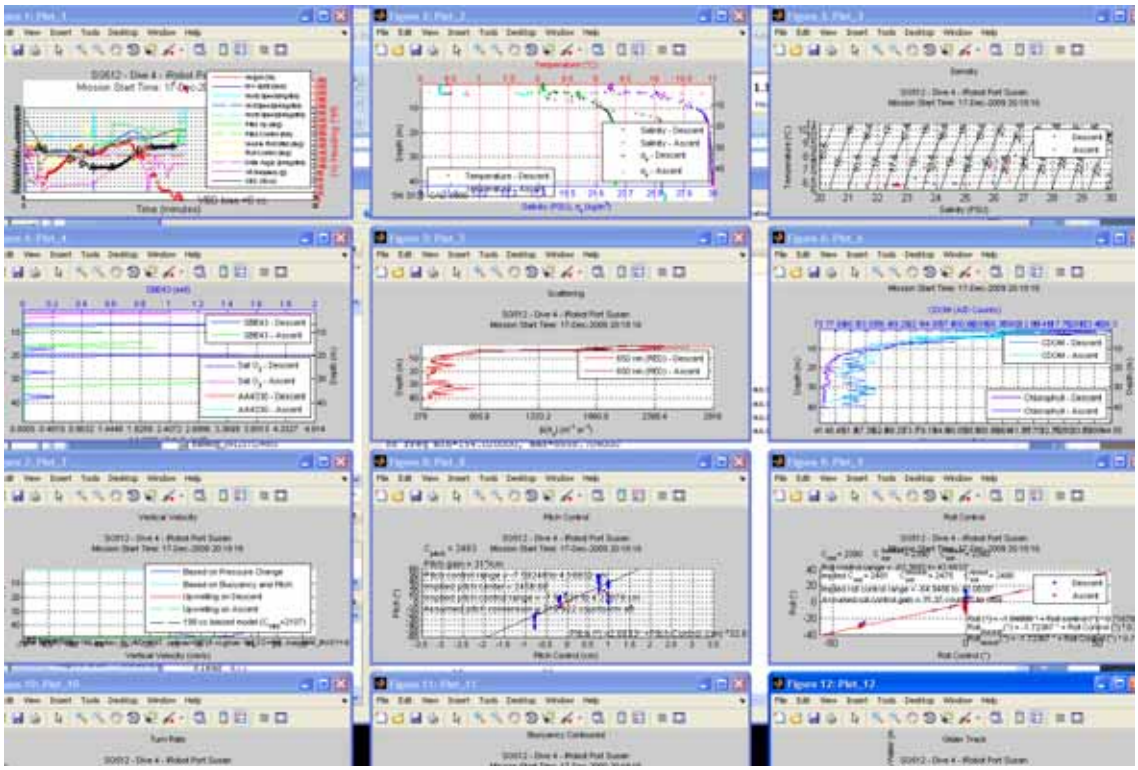


Figure D-8. Example of Auto-tile Plot function

Visualizations

Multiple graphs are displayed for the variety of data that is collected and reported by the vehicle. Each type of data has a specific graph that is associated with the data. So, for instance, data collected from one or more oxygen sensors will be plotted on the same graph. The following subsections will discuss in detail each data type visualized by the software.

Graphs for which no data exists will display a message on the graph indicating that no data exists for the dive being analyzed. So for example, if no oxygen data exists for the dive a message such as "Oxygen data does not exist for this dive," will be displayed on the graph. Refer to the subsections below for messages specific to the plot. If the *sg_calib_constants.m* file is missing or the input/format is incorrect, the plots may not plot as intended; In this event, the Dive Data Analysis Software may display the raw data or may not show the data at all. Review *sg_calib_constants.m* file for correctness before generating plots.

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Plot 1: Composite plot

Plot 1 (Figure D-9) presents a composite graph including the following dive characteristics:

- Velocities (Horizontal and Vertical). Horizontal velocity is represented by the horizontal speed in the direction of heading. Vertical velocity is presented as a magnitude in the z-direction (perpendicular to the horizon).
- Dive Depth
- Buoyancy
- Pitch/Roll
- Heading

Other than acting as a general flight check, this plot primarily aids in providing a value to the pilot for changes in the parameter $C_VBD. This can be determined by looking at the vertical velocity (w = dz/dt) versus the VBD. Rule of Thumb: If VBD line crosses 0 depth before w line, glider is heavy; if glider is too heavy, decrease $C_VBD. And vice versa: If w line crosses 0 depth before VBD line, glider is light; if glider is too light, increase $C_VBD.

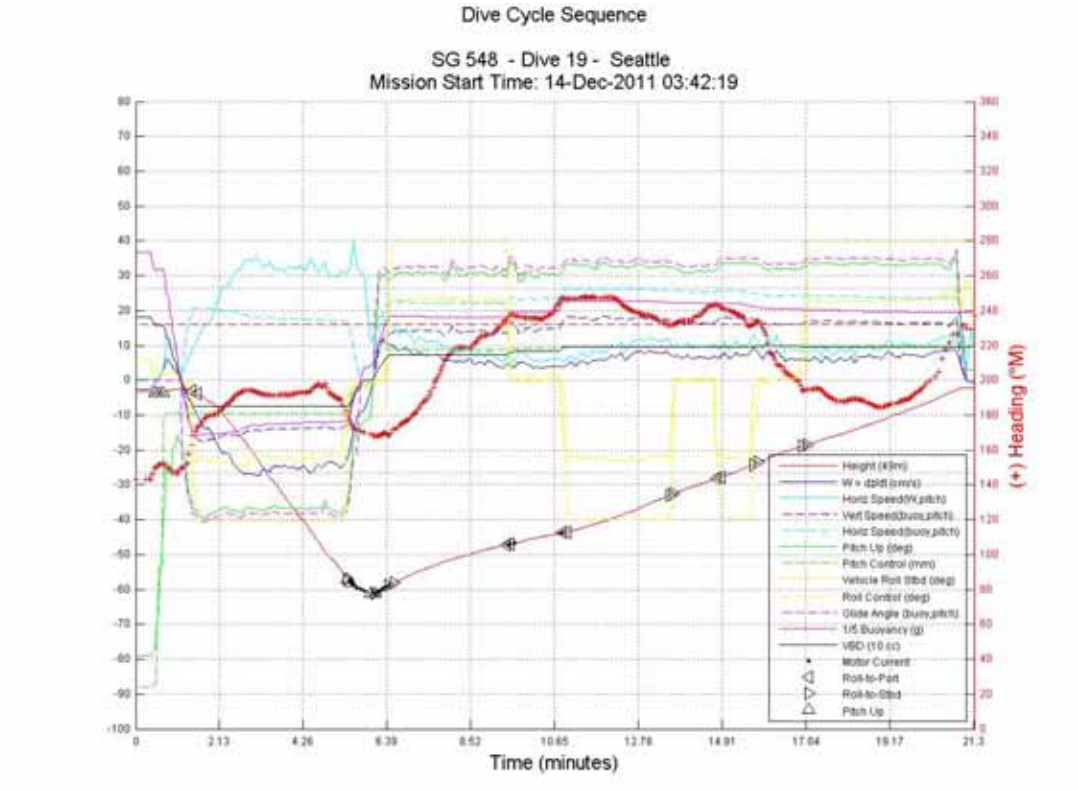


Figure D-9. Plot 1: Composite plot

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Plot 2: CTD plot (from Sea-Bird CT Sail or Sea-Bird GPTCD)

Plot 2 presents CTD data as Depth vs. Salinity and Temperature on both the descent and ascent (Figure D-10). The depth data is measured through the glider's pressure sensor. Several colors are used to denote temperature and salinity on descent and ascent. PSU indicates practical salinity units.

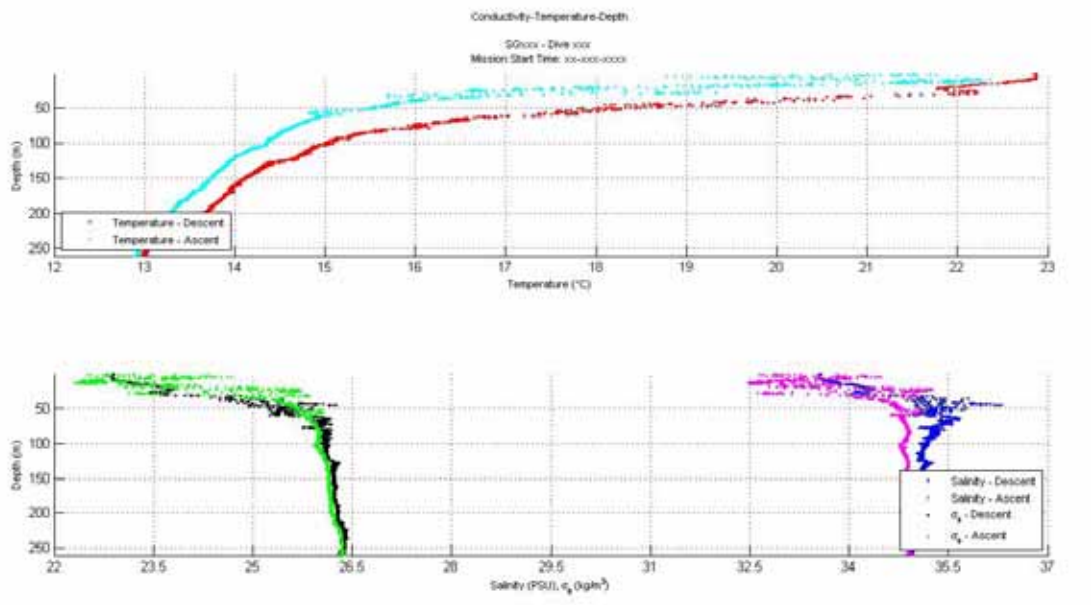


Figure D-10. Plot 2: CTD plot

NOTE: When CTD data is not present or sg_calib_constants.m file is incorrect, the message "CTD data does not exist for this dive!" appears.

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Plot 3: T-S plot: (from Sea-Bird CT Sail or Sea-Bird GPTCD)

The Temperature-Salinity (T-S) Plot displays the relationship between temperature, salinity, and density (Figure D-11). Density is displayed on the plot as isopycnal curves. Densities are plotted in different colors for both the dive descent and ascent. PSU indicates practical salinity units.

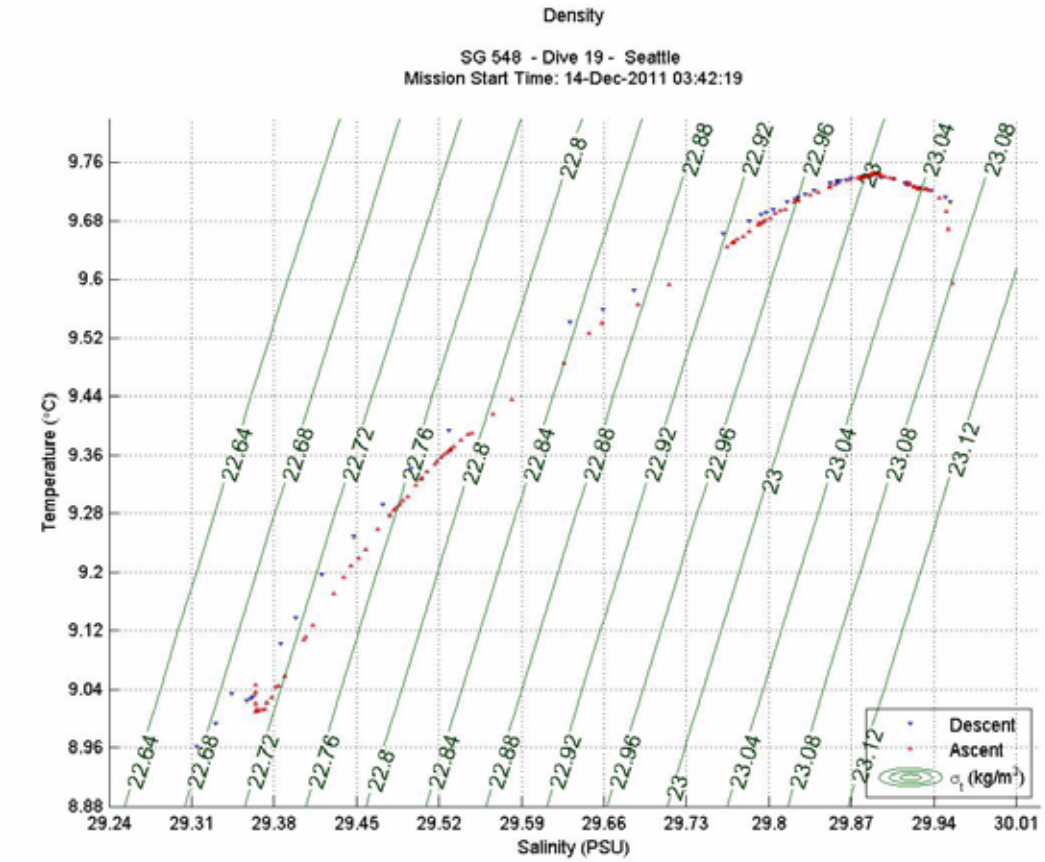


Figure D-11. Plot 3: T-S plot

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Plot 4: Dissolved oxygen plot (SBE DO, and/or Aanderaa DO sensor)

The dissolved oxygen plot will plot all oxygen data collected during the dive (Figure D-12). Oxygen data collected will be plotted using colors to distinguish data gathered on the descent and ascent. Examples of plots below; one plot is a configured glider with two dissolved oxygen (DO) sensors, one plot is a configured glider with 1 DO sensor, and 1 is a configured glider with no DO sensor.

If oxygen data is available, the graph will also display oxygen saturation data (Figure D-13). Oxygen saturation data is calculated using the Seawater library (part of the MATLAB scripts). The Seawater library uses salinity, temperature, and pressure for this calculation and does ***not*** require oxygen data acquired from DO sensor. It is simply added to the DO plot as it is more relevant here than on the CTD plot; therefore, the oxygen saturation data will only be plotted if oxygen data is available to plot. If no oxygen data is available, the plot will read “Oxygen data does not exist for this dive” and the oxygen saturation will not be plotted.

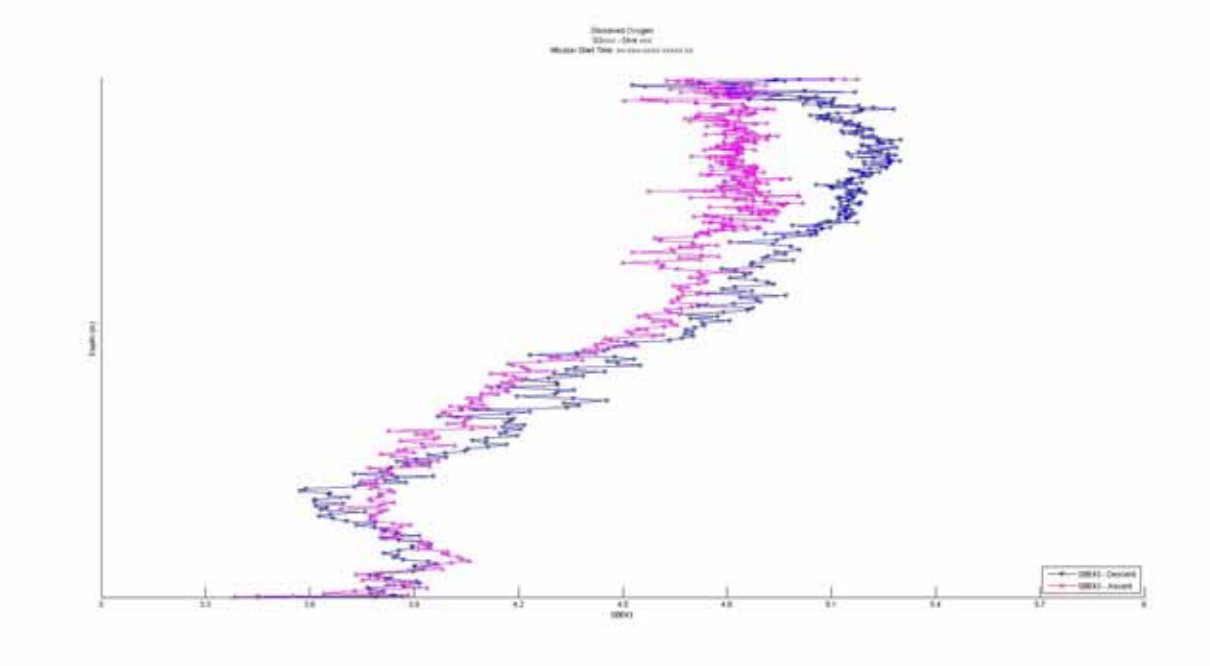


Figure D-12. Dissolved oxygen plot

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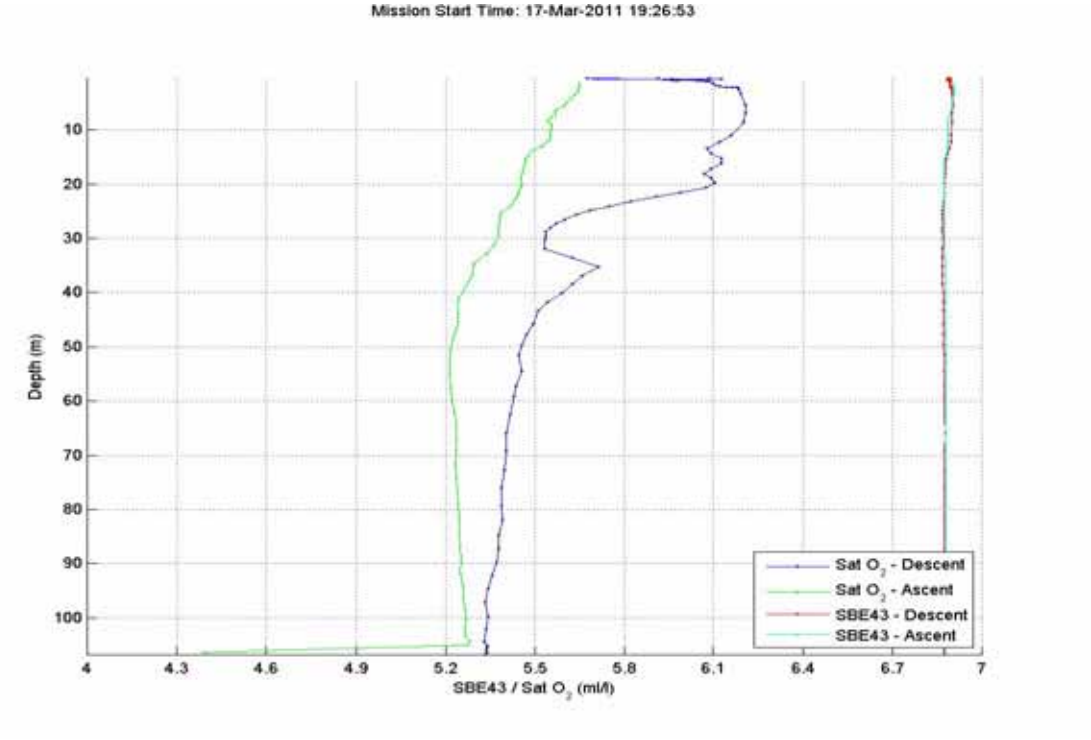


Figure D-13. Oxygen saturation data

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Plot 5: Backscatter plot (WET Labs Triplets)

The backscatter plot displays measured wavelengths of signals from concentrations of material in the water. Depending on what triplet is sensor is installed, up to three backscatter measurements may be present. In this case the sensor provides optical backscattering measurements at 650nm excitation on both the descent and ascent. Depending on the triplet installed, more than one wavelength may be displayed. As seen below, the first triplet only has 1 backscatter in the triplet configuration (Figure D-14), whereas, the second plot below has 2 backscatter in the triplet configuration (Figure D-15).

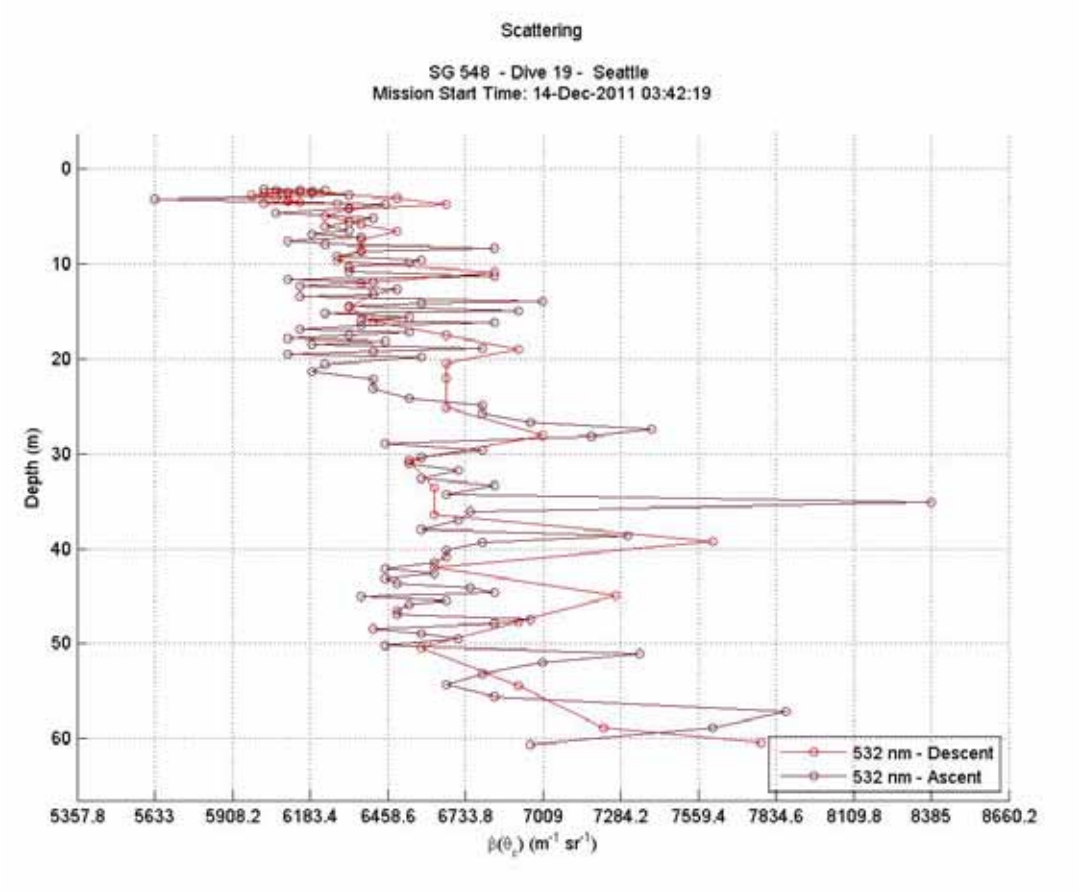


Figure D-14. Plot 5: One backscatter plot in triplet configuration

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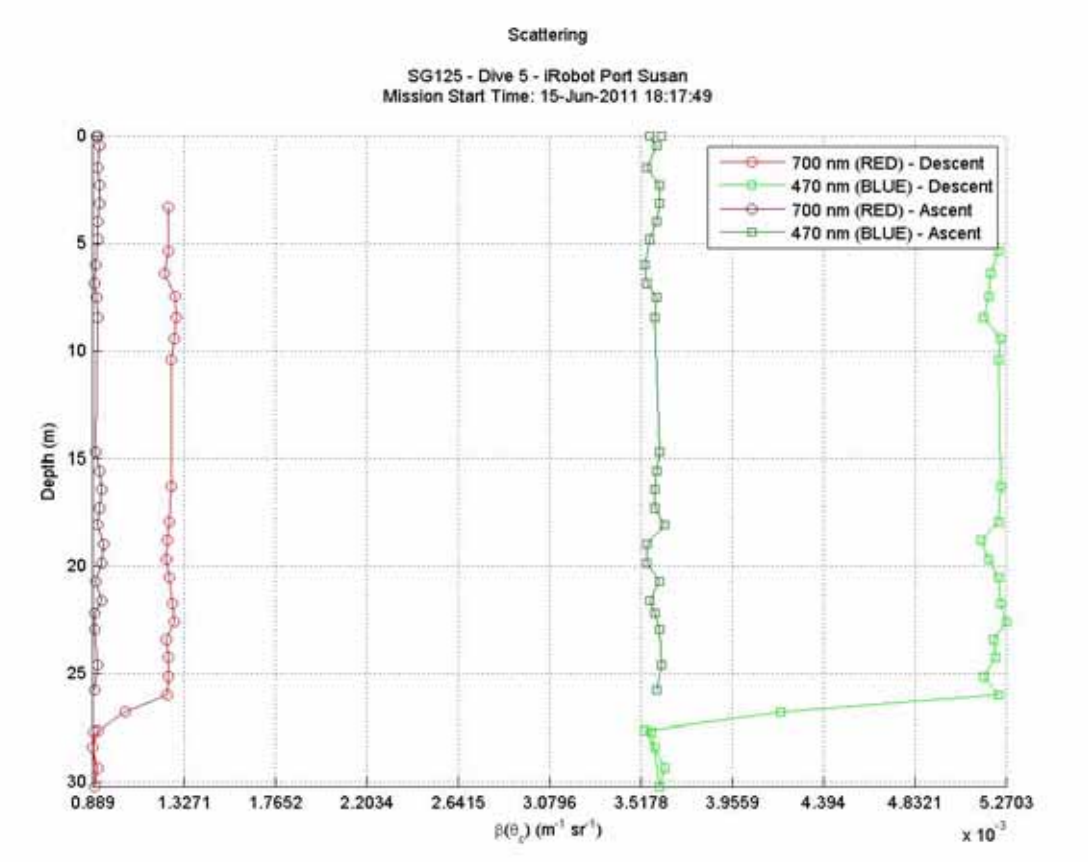


Figure D-15. Two backscatter plots in triplet configuration

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Plot 6: Fluorometer data (WET labs triplets)

The fluorometer plot displays the fluorescent response of substances in the water on the descent and ascent of the dive in different colors. In this case, CDOM and chlorophyll data are plotted (Figure D-16).

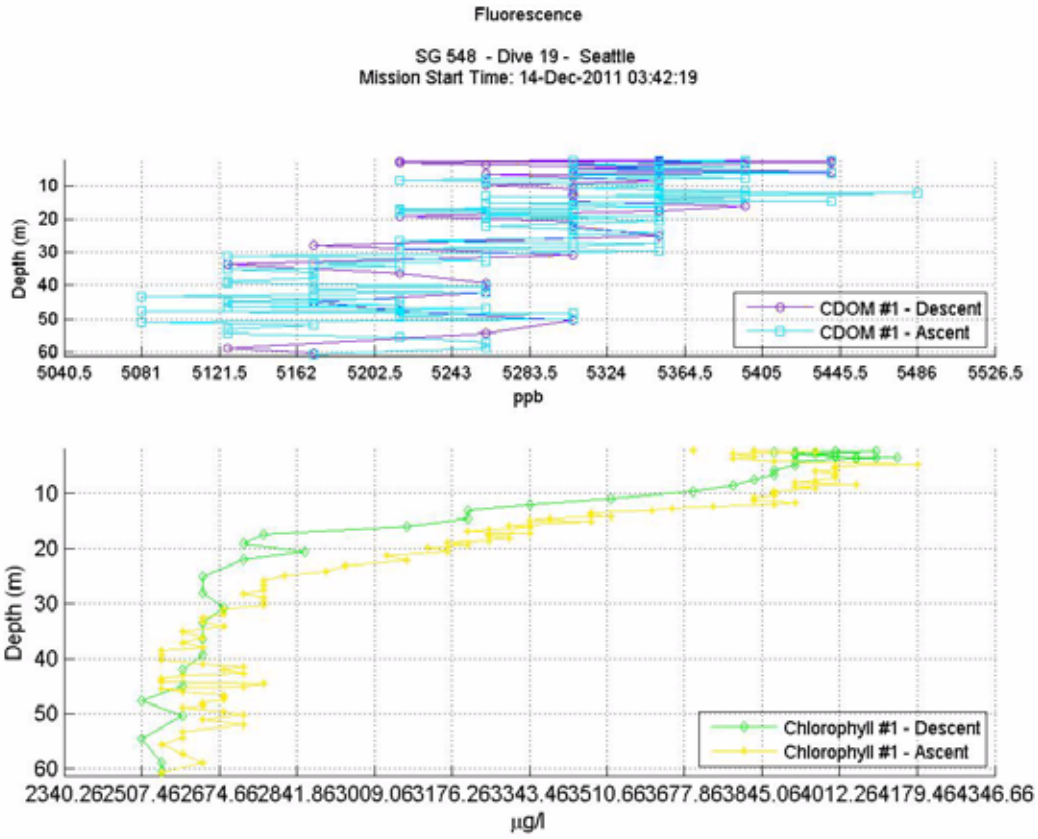


Figure D-16. Plot 6: Fluorometer data

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Plot 7: Vertical velocity

The vertical velocity plot measures vertical velocity (cm/s) on the dive's descent and ascent. The plot shows the vertical velocity of the glider based on 5 different methods of calculation (Figure D-17). Ideally the pilot would like to see these centered around the same velocity throughout the entire dive. Ex: -15cm/s on dive and +15cm/s on the ascent.

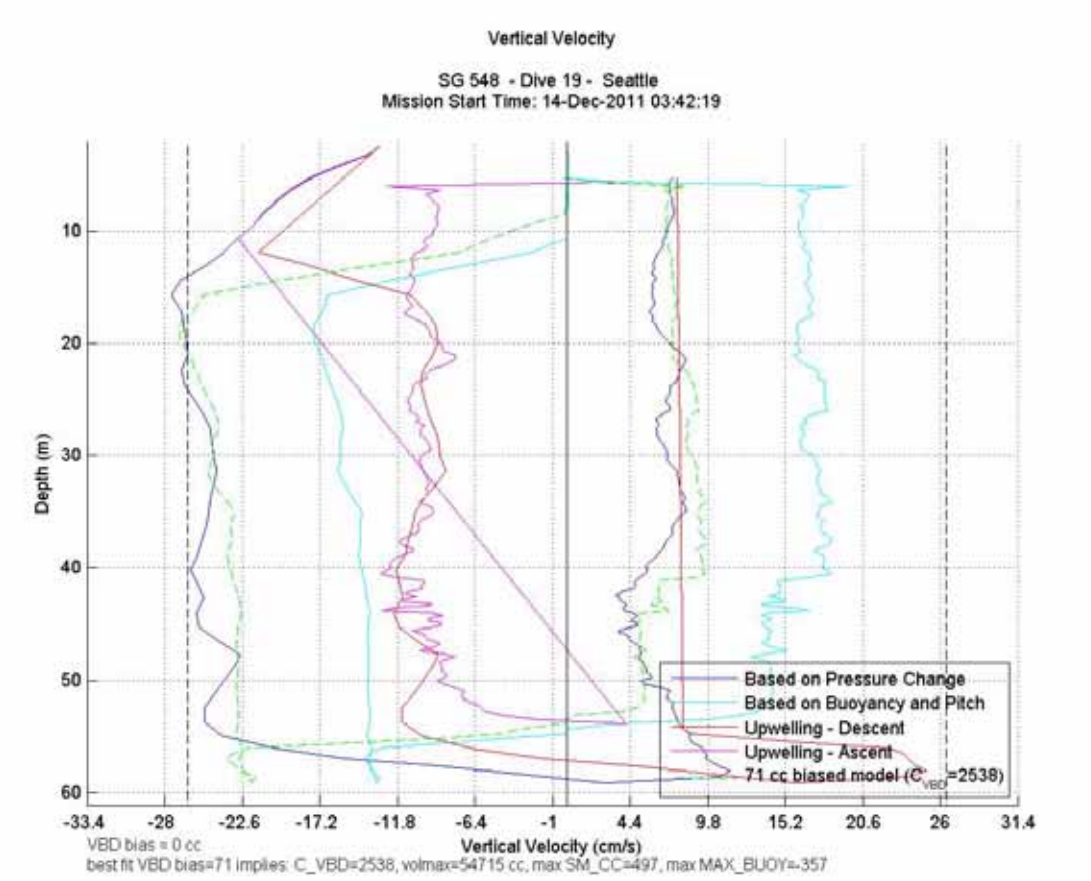


Figure D-17. Plot 7: Vertical velocity

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Plot 8: Pitch control plot

The following pitch control plot displays the current pitch center and gain (C_PITCH, and PITCH_GAIN) parameters (Figure D-18). Ideally the pilot would want the cm per degree regression line to cross through (0,0). The recommended pitch center and gain is also calculated and displayed on the plot. In the example below, changes are not necessary. The pitch center is off by 14 counts and the pitch gain is off by 0.6.

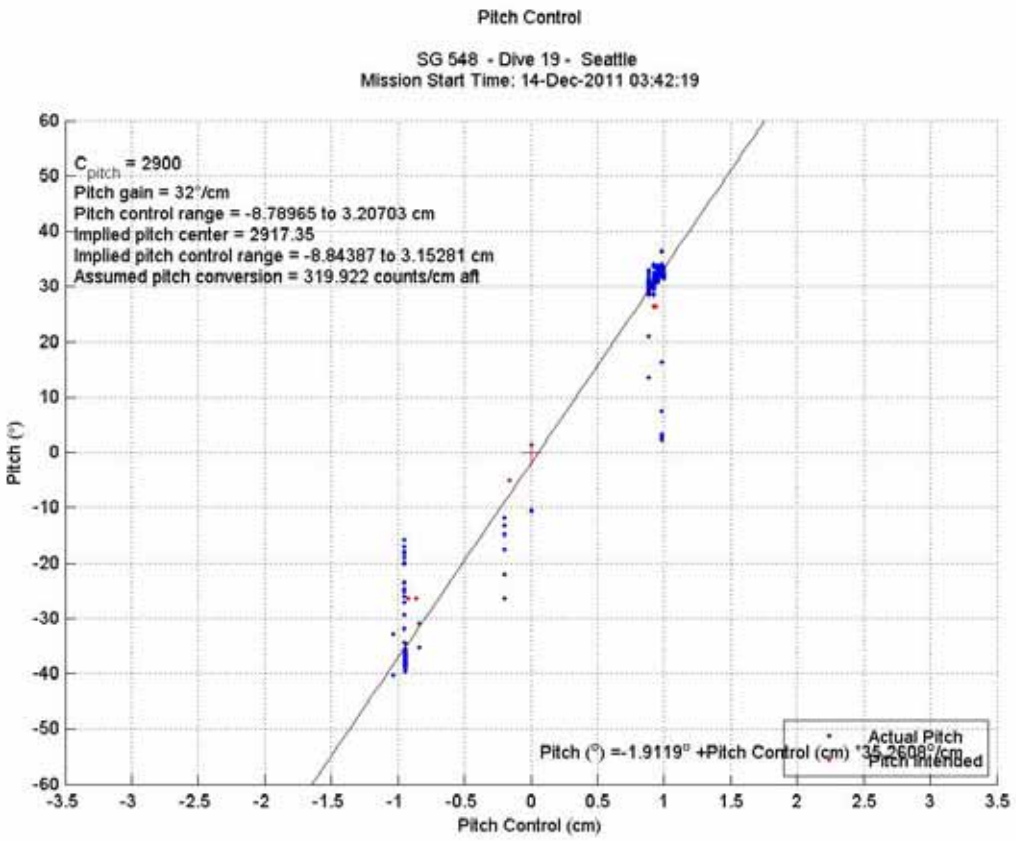

Pitch Control
SG 548 - Dive 19 - Seattle
Mission Start Time: 14-Dec-2011 03:42:19
C pitch = 2900
Pitch gain = 32°/cm
Pitch control range = -8.78965 to 3.20703 cm
Implied pitch center = 2917.35
Implied pitch control range = -8.84387 to 3.15281 cm
Assumed pitch conversion = 319.922 counts/cm afl
Pitch (°)
Pitch Control (cm)
Actual Pitch
Pitch Intended

Figure D-18. Plot 8: Pitch control plot

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Plot 9: Roll control

Roll control is displayed on plot 9 (Figure D-19). The plot displays the roll control on the descent and ascent as well as the current roll centers and gain values. The roll center parameters are adjusted by pilots (C_ROLL_DIVE, C_ROLL_CLIMB); Ideally, both regression lines should pass through (0,0).

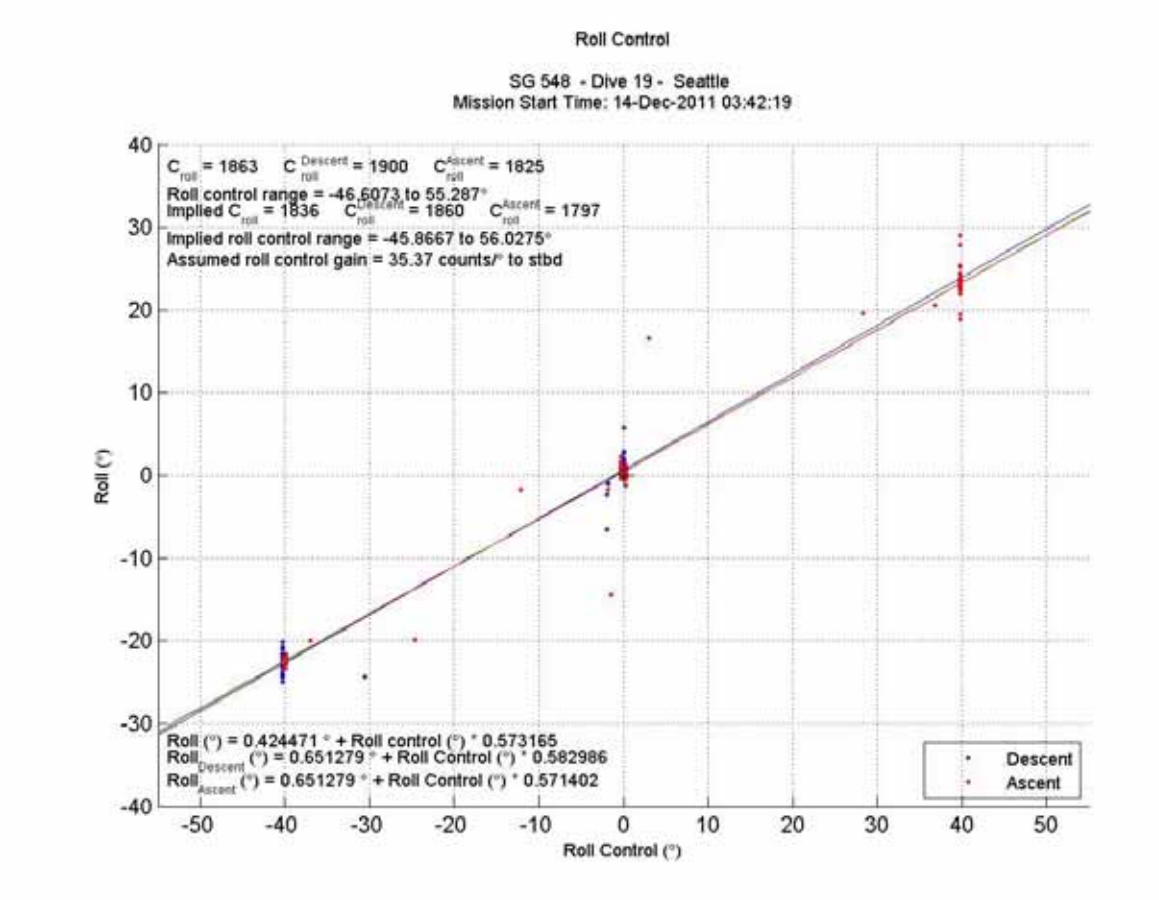


Figure D-19. Plot 9: Roll control

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Plot 10: Turn rate plot

The turn rate plot displays Turn Rate (deg/sec) vs. Roll Control (deg). Roll centers and gain are also displayed on this plot. This plot is used frequently in pilot control. Ideally, the descent and ascent should create an X pattern crossing at (0,0). The red and blue dots should be offset equally from the turn rate = 0 line. The red and blue lines should also run through the center of the red and blue dots, respectively.

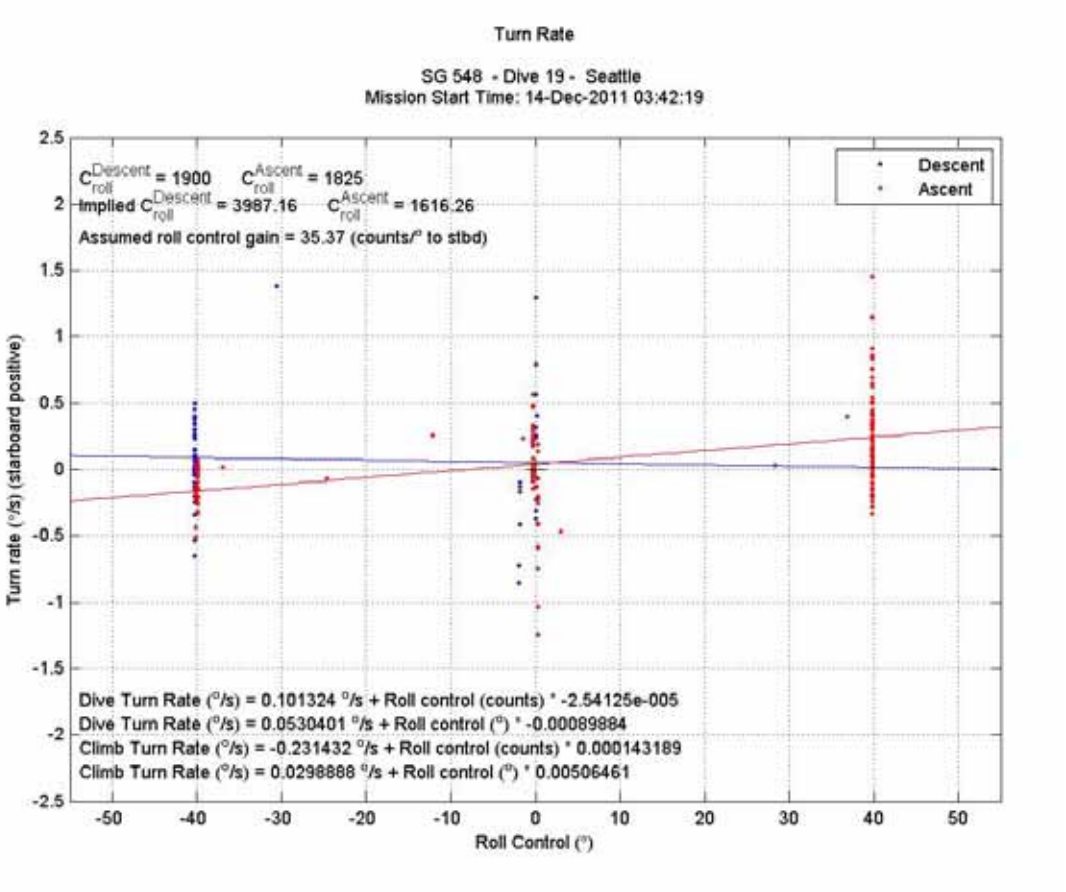

Turn Rate
SG 548 - Dive 19 - Seattle
Mission Start Time: 14-Dec-2011 03:42:19
$C_{roll}^{Descent}$ = 1900 C_{roll}^{Ascent} = 1825
Implied $C_{roll}^{Descent}$ = 3987.16 C_{roll}^{Ascent} = 1616.26
Assumed roll control gain = 35.37 (counts/° to stbd)
Descent
Ascent
Turn rate (°/s) (starboard positive)
Roll Control (°)
Dive Turn Rate (°/s) = 0.101324 °/s + Roll control (counts) * -2.54125e-005
Dive Turn Rate (°/s) = 0.0530401 °/s + Roll control (°) * -0.00089884
Climb Turn Rate (°/s) = -0.231432 °/s + Roll control (counts) * 0.000143189
Climb Turn Rate (°/s) = 0.0298888 °/s + Roll control (°) * 0.00506461

Figure D-20. Plot 10: Turn rate plot

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Plot 11: Buoyancy contoured plot

The Buoyancy Plot displays VBD in cc's at different σ_T. The plot also displays the current C_VBD, SM_CC (surface maneuver cc's and the recommended cc's, $CC_{surfmin}$, needed at the surface. Implied mass at apogee is also displayed however this is not typically used while piloting. This plot allows the pilot to set optimal SM_CC for energy savings.

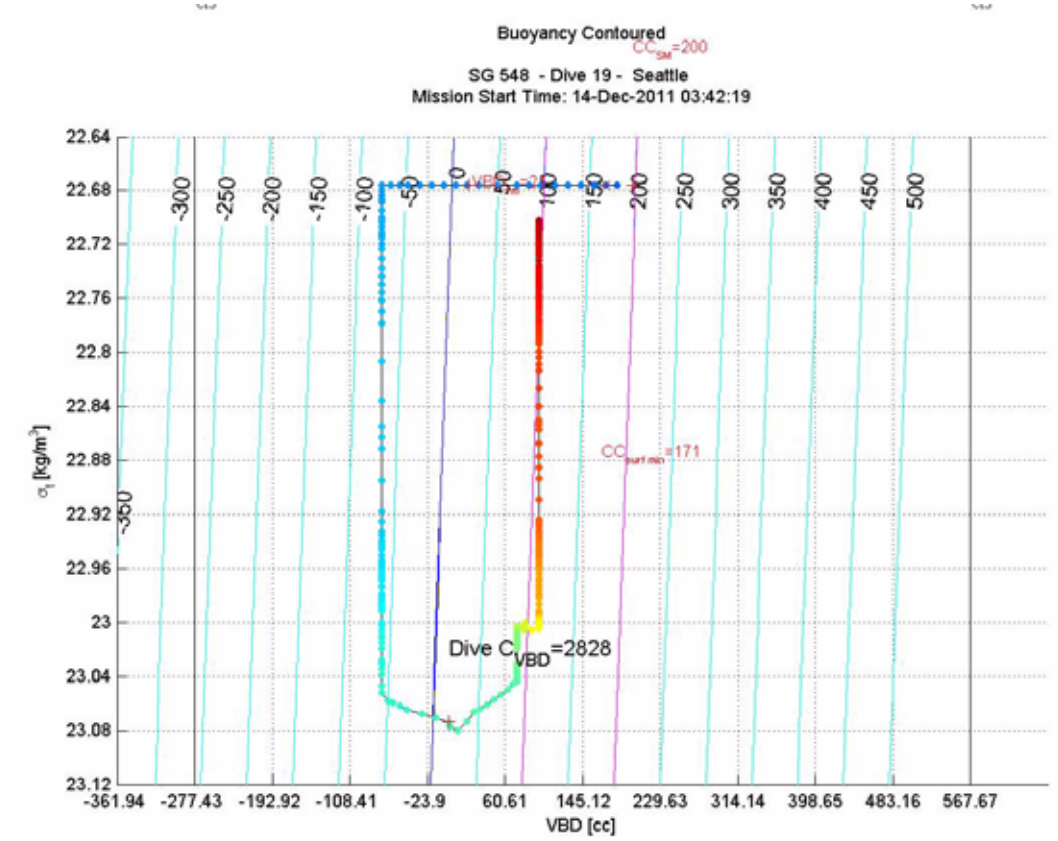


Figure D-21. Plot 11: Buoyancy contoured plot

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Plot 12: Glider track plot

The glider track plot displays the track and heading from an aerial view (Figure D-22). Several flight characteristics can be viewed from this plot:

- Average Speed through water
- Distance through water
- Maximum Buoyancy (set by pilot)
- Current Target
- Glide Slopes

Also, a 'V'on the plot represents the heading error band. The actual track of the glider shows roll maneuvers indicated by the red and green dots.

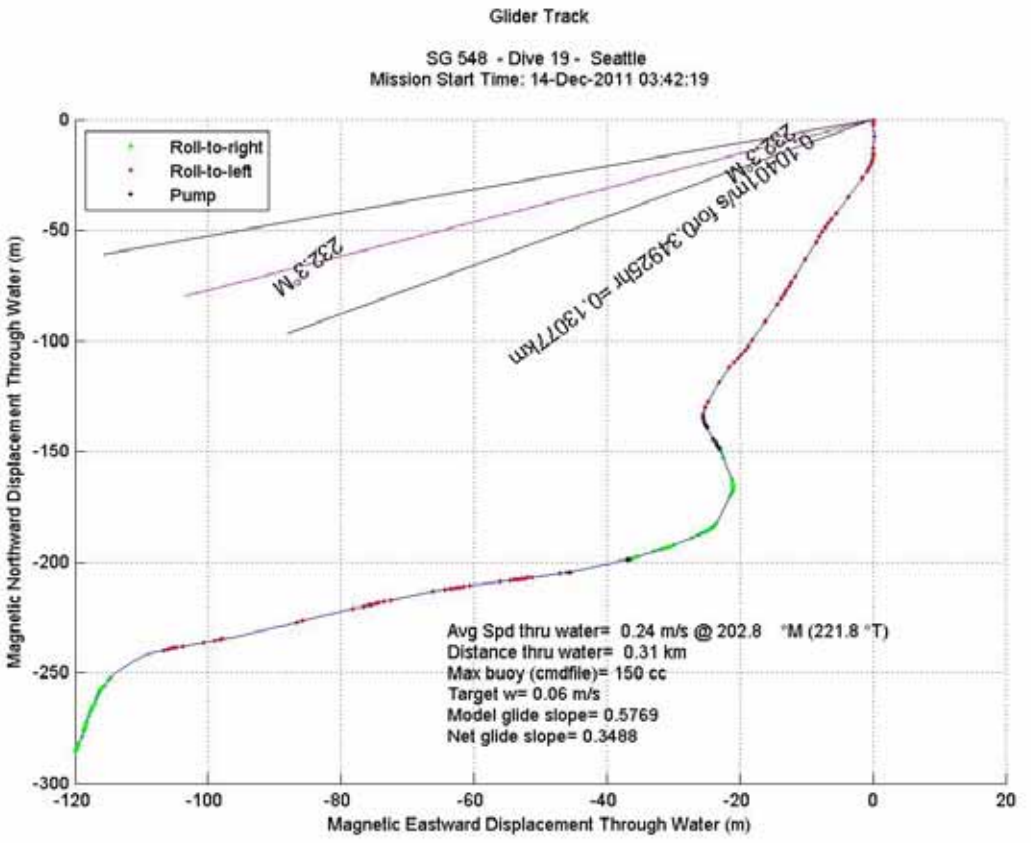


Figure D-22. Plot 12: Glider track plot

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Plot 13: Speed of sound

Figure D-23 shows the plot of the speed of sound in m/s at varying depths.

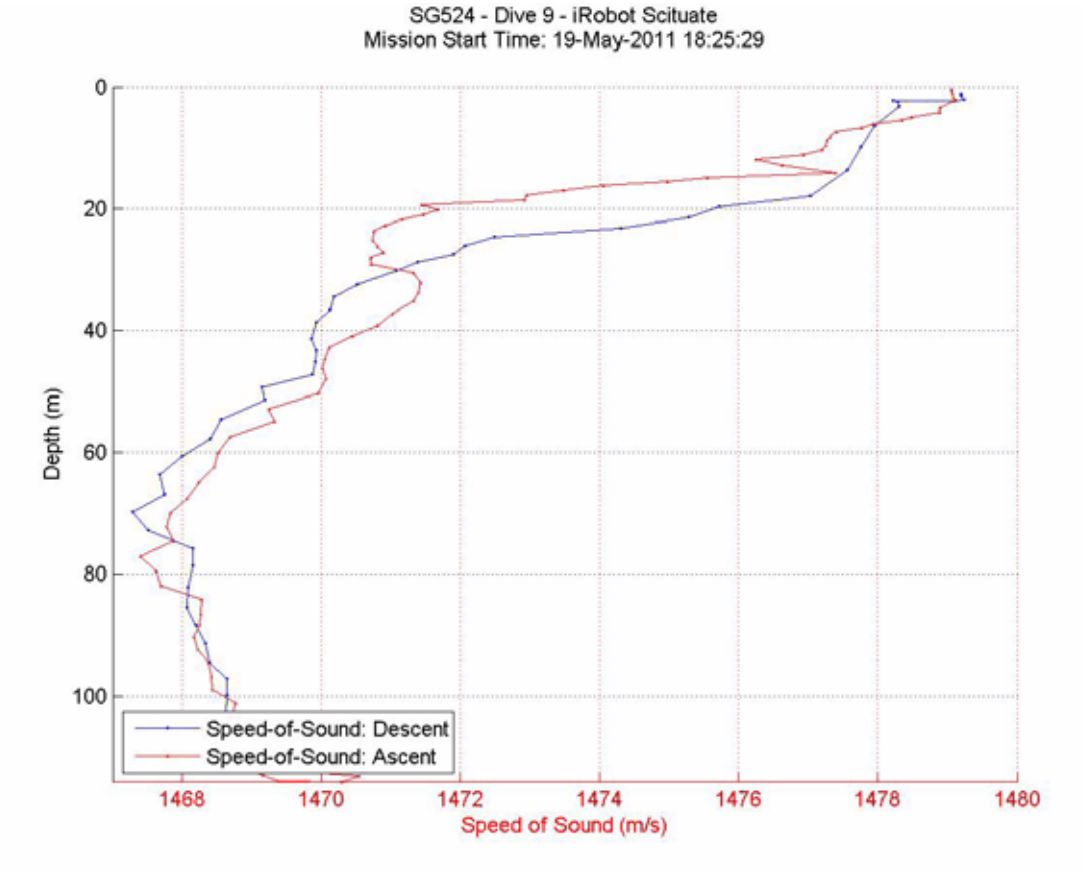


Figure D-23. Plot 13: Speed of sound

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Plot 14: PAR (Photosynthetically Active Radiation) sensor data

The PAR sensor measures the spectral range of solar radiation (400-700nm) used by aquatic plants and algae for photosynthesis. At deeper depths you will see the par sensor decrease to zero as solar radiation diminishes with depth (Figure D-24).

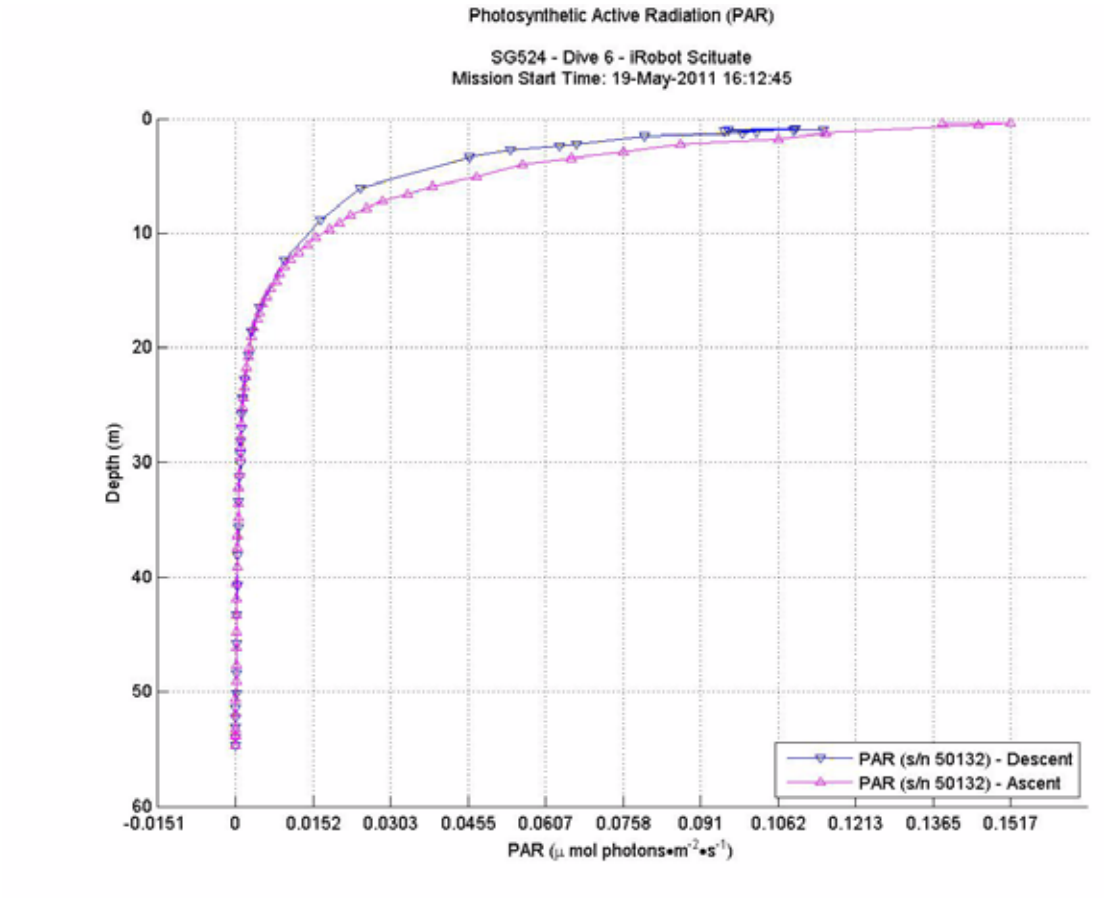


Figure D-24. Plot 14: PAR sensor data

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APPENDIX E

Autonomous Self Test

Autonomous self test

This appendix contains the autonomous self test.

```
Version 66.07.14/18:2975 starting up Aug  3 2012 09:07:53
Seaglider operating software developed and maintained by
Applied Physics Laboratory, University of Washington
Copyright 2003-2010, University of Washington
Built with SCENARIO, without ICE, without RAFOS, without KERMIT,
     without ARS, without MMODEM, without PAAM, without AQUADOPP, without SAILCT,
    without DEEPGLIDER, without HEAP RECYCLE, with REV_C, without LUA
with serial and logger device sensor integration facilities
developed by Integrative Observational Platforms Group, APL-UW
_mtop = 0x2fefff, _mbot = 0x290fb0, _mcur = 0x292000
glmalloc_init: glmalloc_data_init = 0x0
glmalloc_init: avail_bytes = 417791, requested_bytes = 358400
glmalloc_init: Allocated 358400 bytes.
2.363,SSENSOR,N,reading cnf WLBB2FL.cnf
3.123,SSENSOR,N,reading cnf WLBBFL2.cnf
3.881,SSENSOR,N,reading cnf qsp2150.cnf
4.575,SSENSOR,N,reading cnf WLBB2FL.cnf
5.427,SSENSOR,C,reading cnf ncp.cnf
5.819,SSENSOR,N,assigned SBE_CT serial number 1234 to sensor slot 1 (p = 2)
6.705,SPOWER,N,Iridium_during_init saved current=0.10300
6.874,SPOWER,N,Iridium_during_connect saved current=0.16000
7.047,SPOWER,N,Iridium_during_xfer saved current=0.22300
7.217,SPOWER,N,GPS saved current=0.02696
7.365,SPOWER,N,TT8 saved current=0.01496
7.513,SPOWER,N,TT8_Active saved current=0.01421
7.672,SPOWER,N,TT8_Sampling saved current=0.03743
7.833,SPOWER,N,TT8_CF8 saved current=0.04717
7.988,SPOWER,N,TT8_Kalman saved current=0.05915
8.149,SPOWER,N,Analog_circuits saved current=0.01200
8.315,SPOWER,N,Compass saved current=0.01573
8.515,HCOMPASS,N,Active compass is SP3003
8.721,SSYS,N,Changing capture file
12.317,SUSR,N,Glider 123, mission 0, dive 12, booted Thu Jan  1 00:00:12 1970
, boot #1623
13.381,HXPDR,N,max range = 60.000000 m, timeout = 80 ms
13.677,SSURF,N,Hit CR within 1 minute to start, otherwise will go to recovery ...
Set current date and time
<CR> for default [08/03/2012 09:07:53]
Are you running on external (bench) power? [N]
```


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```
------ Main Menu ------
    1 [param   ]  Parameters and configuration
    2 [hw      ]  Hardware tests and monitoring
    3 [modes   ]  Test operation modes and files
    4 [pdos    ]  PicoDOS commands (and exit)
    5 [launch  ]  Pre-launch
Enter selection (1-5,CR): 5

------ Launch Menu ------
    1 [scene   ]  Set scenario mode
    2 [selftest]  Perform interactive self test
    3 [autotest]  Perform autonomous self test
    4 [uploadst]  Upload self-test results
    5 [reset   ]  Reset dive/run number
    6 [test    ]  Test Launch!
    7 [sea     ]  Sea Launch!
   CR)  Return to previous
Enter selection (1-7,CR): 3
9.831,SUSR,N,Beginning selftest #63 on glider SG123
0.115,SUSR,N,Fri Aug  3 09:08:05 2012
0.207,SUSR,N,---- Audible pings to mark start of tests ----
0.695,HXPDR,N,ping response: R005.731ms

0.756,HXPDR,N,range was 4.298250 m
2.842,HXPDR,N,ping response: R---------

2.903,HXPDR,N,range was 999.000000 m
4.990,HXPDR,N,ping response: R---------

5.051,HXPDR,N,range was 999.000000 m
6.988,SUSR,N,clearing tranponder ping count, prev count=0
7.108,SUSR,N,xpdr/ranging can be tested while other tests proceed
7.232,SUSR,N,---- Checking GPS ----
7.315,HGPS,N,Obtaining GPS fix
28.515,HGPS,N,0 recent almanac sentences returned, consider acquiring new almanac data
28.632,HTT8,N,Updating parameter $T_GPS_CHARGE to -20733.295
31.300,HGPS,N,Acquiring GPS fix ...
33.145,HGPS,N,VVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVVA
3307789.004,HGPS,N,sync sentence $GPRMC,155753,A,3556.3571,N,07854.1086,W,000.0,000.0,100912,008.7,W*76
3307789.134,HGPS,N,set 2012/09/10 15:57:54
3307789.603,HGPS,N,confirm $GPRMC,155754,A,3556.3576,N,07854.1092,W,000.0,000.0,100912,008.7,W*73
3307789.746,HGPS,N,100912, 155752, 3556.356689, -7854.109863 0.900000 36/36 seconds
3307790.362,HTT8,N,Updating parameter $T_GPS_CHARGE to -20734.646
3307793.043,SUSR,N,---- Checking Iridium phone ----
3307793.152,SUSR,N,---- Checking bathymetry data ----
3307793.264,SUSR,N,Normal Heap: 0+57343 bytes
3307793.425,SGLMALLOC,N,glheap_walk: 353464 bytes free, 1 blocks free, 3784 bytes alloc, 47 blocks alloc
3307796.259,SBATHY,N,Loaded bathymap.001 [101 100] 100m (LL) 47.8833,-122.4000 (UR) 47.9742,-122.2658
3307802.107,SBATHY,N,Loaded bathymap.002 [102 112] 100m (LL) 47.9500,-122.3833 (UR) 48.0418,-122.2328
3307806.349,SBATHY,N,Loaded bathymap.003 [ 47 174] 100m (LL) 48.0333,-122.4667 (UR) 48.0756,-122.2325
3307813.924,SBATHY,N,Loaded bathymap.004 [112 137] 100m (LL) 48.0667,-122.4833 (UR) 48.1675,-122.2988
3307814.275,SBATHY,N,WARNING: No bathymetry file covers the current location (3556.356689,-7854.109863)!
3307814.519,SGLMALLOC,N,glheap_walk: 322528 bytes free, 2 blocks free, 34648 bytes alloc, 49 blocks alloc
3307814.708,SUSR,N,---- Checking compass and calibration files ----
3307814.920,HCOMPASS,N,Compass 1, SP3003
3307815.052,HCOMPASS,N,pitch A,B,C,D: 0.000000 1.000000 0.000000 0.000000
3307815.229,HCOMPASS,N,roll A,B,C,D:  0.000000 1.000000 0.000000 0.000000
3307815.379,HCOMPASS,N,hard iron P,Q,R: 0.000000 0.000000 0.000000
3307815.540,HCOMPASS,N,soft iron: 1.000000 0.000000 0.000000
3307815.693,HCOMPASS,N,          0.000000 1.000000 0.000000
3307815.845,HCOMPASS,N,          0.000000 0.000000 1.000000
3307817.362,HCOMPASS,N,compass filter disabled ok
3307818.111,HCOMPASS,N,.....1, SP3003, Hdg: 80.78 deg Rol: 3.84 deg Pit: 1.88 deg Tmp: 26.42 C
3307851.951,SUSR,N,---- Reporting hardware configuration ----
3307852.097,SUSR,N,Sensor in slot 1 is SBE_CT serial number 1234 on port 2, TPU04/TPU05, nominally 'CT'
3307852.277,SUSR,N,Sensor in slot 2 is not installed
3307852.388,SUSR,N,Sensor in slot 3 is not installed
3307852.824,SUSR,N,Sensor in slot 4 is not installed
3307852.935,SUSR,N,Sensor in slot 5 is not installed
3307853.046,SUSR,N,Sensor in slot 6 is not installed
3307853.160,SUSR,N,Logger Sensor in logger slot 1 is not installed
3307853.293,SUSR,N,Logger Sensor in logger slot 2 is not installed
3307853.426,SUSR,N,Logger Sensor in logger slot 3 is not installed
```


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3307853.559,SUSR,N,Logger Sensor in logger slot 4 is not installed
3307853.686,SUSR,N,Motherboard is Rev.B.1
3307853.777,SUSR,N,Phone is Iridium9522
3307853.865,SUSR,N,GPS is Garmin_GPS15H
3307853.954,SUSR,N,Compass is SP3003
3307854.040,SUSR,N,Spare compass is not installed
3307854.143,SUSR,N,XPDR is AAE_955
3307854.286,SUSR,N,External pressure sensor gain (128.000000) consistent with Paine
3307854.439,SUSR,N,---- Reporting software version ----
3307854.549,SUSR,N,Version: 66.07.14
3307854.637,SUSR,N,Compiled on: Aug  3 2012 09:07:53
3307854.744,SUSR,N,From SVN version 18:2975
3307854.837,SUSR,N,Compiler: gcc
3307854.920,SUSR,N,Compiled with SCENARIO support
3307855.024,SUSR,N,Compiled without ICE support
3307855.127,SUSR,N,Compiled without RAFOS support
3307855.232,SUSR,N,Compiled without Kermit support
3307855.338,SUSR,N,Compiled without ARS support
3307855.440,SUSR,N,Compiled without PAAM support
3307855.545,SUSR,N,Compiled without AQUADOPP support
3307855.654,SUSR,N,Compiled without SAILCT support
3307855.761,SUSR,N,Compiled without MicroModem support
3307855.874,SUSR,N,Compiled without DeepGlider support
3307855.988,SUSR,N,Compiled without Heap Recycle support
3307856.105,SUSR,N,Compiled with Rev C Motherboard support
3307856.222,SUSR,N,Compiled without LUA support
3307856.334,SUSR,N,NVRAM: 191 parameters, 768 bytes, 186 bytes in utility storage
3307856.479,SUSR,N,Buffers: static
3307856.560,SUSR,N,Active (2Mhz)
3307856.641,SUSR,N,PicoDOS version: C82#2535-1.63b
3307856.745,SUSR,N,Launched as: MAIN
3307856.835,SUSR,N,Normal Heap: 0+57343 bytes
3307857.002,SGLMALLOC,N,glheap_walk: 322488 bytes free, 2 blocks free, 34664 bytes alloc, 50 blocks alloc
3307857.176,SUSR,N,Sensors: SBE_CT
3307857.636,SUSR,N,MAIN.RUN: 506484 bytes
3307857.732,SUSR,N,---- Reporting directory contents ----
BATHYMAP.001        33792
BATHYMAP.002        38272
BATHYMAP.003        26752
BATHYMAP.004        48896
CURRENTS              220
IES.CNF              220
IES_GO               286
IES_SMP              151
MAIN.RUN          506484
NCP.CNF             1016
NCP_CS               250
NCP_DL               124
NCP_GO               371
SG001PRM.TXT        2785
TCM2MAT.123          192
GPCTD.CNF            819
GPCTDDO.CNF          853
QSP2150.CNF          128
SCIENCE              139
TARGETS              351
WLBB2F.CNF           195
WLBB2FL.CNF          222
WLBB3.CNF            194
WLBBFL2.CNF          230
THISDIVE.KAP        6252
THISDIVE.DAT         677
THISDIVE.LOG        4395
THISDIVE.WRK          18
BATTERY              449
BG091012             447
CMDFILE               18
ST0062KZ.A         10682
ST0061LU.A          4356
ST0061DU.A           835
LOGGERS.CMD            0
ST0062LU.A          4395
ST0062DU.A           677
```


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```
696143 bytes used; 37 files
3307859.262,SUSR,N,---- Checking pressure sensor ----
3307860.565,HPRES,N,              A/D        Volts     Meters
3307860.815,HPRES,N, Mean:         398732.7   0.463258   0.03
3307861.086,HPRES,N, RMS:          398732.8   0.463258   0.03
3307861.298,HPRES,N, Min:          397845     0.462226   -0.04
3307861.510,HPRES,N, Max:          399471     0.464115   0.09
3307861.687,HPRES,N, Peak-to-peak:  1626       1.889127   uV

3307861.854,HPRES,N, Volts per bit: 1.161825e-09

3307861.960,HPRES,N,Y-intercept is set correctly
3307862.088,SUSR,N,---- Checking pitch, roll, and VBD. ----
3307862.207,SUSR,N,---- Checking pitch motor ----
3307862.308,SUSR,N,Pitching up...
3307862.513,HPITCH,N,Pitch commanded from -4.57 cm (1239) to 1.88 cm (3300)...
3307863.523,HPITCH,N,-4.3 cm (ad: 1334) .................MOTOR_DONE: ticks: 12 max 24v: 3.8mA avg 24v: 3.1mA minV 24v: 23.8V
3307872.993,SMOTOR,N,GC TICKS/TIME: 386/388309
3307873.089,HPITCH,N,done.
3307873.233,HPITCH,N,Pitch completed from -4.57 cm (1239) to 1.88 cm (3301) took 9.3 sec 26mA (183mA peak) 23.7Vmin 222 AD/sec 371
ticks
3307873.630,HPITCH,N,TRACK: b: 3284/0 a: 3287/0 d: 0 o: 14
3307873.744,SUSR,N,Pitching down...
3307873.953,HPITCH,N,Pitch commanded from 1.88 cm (3300) to -6.56 cm (600)...
3307874.933,HPITCH,N,1.6 cm (ad: 3203) ....................
3307885.708,HPITCH,N,-6.0 cm (ad: 792) ..MOTOR_DONE: ticks: 17 max 24v: 5.4mA avg 24v: 3.8mA minV 24v: 23.8V
3307887.305,SMOTOR,N,GC TICKS/TIME: 502/504305
3307887.400,HPITCH,N,done.
3307887.543,HPITCH,N,Pitch completed from 1.88 cm (3301) to -6.59 cm (592) took 12.1 sec 22mA (177mA peak) 23.7Vmin 224 AD/sec 482
ticks
3307887.946,HPITCH,N,TRACK: b: 612/0 a: 609/0 d: 3 o: -17
3307888.061,SUSR,N,Backing off pitch mass...
3307888.279,HPITCH,N,   Pitch control position = -6.59 cm, (AD#= 591 )
3307888.545,HPITCH,N,Pitch commanded from -6.59 cm (591) to -4.59 cm (1230)...
3307889.538,HPITCH,N,-6.3 cm (ad: 687) .....MOTOR_DONE: ticks: 17 max 24v: 4.6mA avg 24v: 3.8mA minV 24v: 23.8V
3307892.705,SMOTOR,N,GC TICKS/TIME: 134/136089
3307892.800,HPITCH,N,done.
3307892.947,HPITCH,N,Pitch completed from -6.59 cm (592) to -4.57 cm (1237) took 2.8 sec 25mA (179mA peak) 23.7Vmin 226 AD/sec 114
ticks
3307893.348,HPITCH,N,TRACK: b: 1218/0 a: 1220/0 d: -3 o: 17
3307893.466,SUSR,N,---- Checking roll motor ----
3307893.567,SUSR,N,Roll to port...
3307893.779,HROLL,N,Roll commanded from -0.03 deg (2024) to 39.97 deg (3439)...
3307894.722,HROLL,N,5.4 deg (ad: 2217) ...no progress madeno progress made..MOTOR_DONE: ticks: 19 max 24v: 3.8mA avg 24v: 3.8mA
minV 24v: 23.8V
3307897.993,SMOTOR,N,GC TICKS/TIME: 138/140234
3307898.089,HROLL,N,done.
3307898.213,HROLL,N,Roll completed from 0.00 deg (2025) to 40.45 deg (3456) took 2.8 sec 29mA (183mA peak) 23.7Vmin 502 AD/sec 114
ticks
3307898.638,HROLL,N,TRACK: b: 3419/0 a: 3423/0 d: -3 o: 33
3307898.753,SUSR,N,Roll to starboard...
3307898.980,HROLL,N,Roll commanded from 40.43 deg (3455) to -40.00 deg (610)...
3307899.573,HROLL,C,no progress made36.3 deg (ad: 3308) no progress made.no progress made.....MOTOR_DONE: ticks: 7 max 24v:
3.8mA avg 24v: 3.8mA minV 24v: 23.7V
3307905.815,SMOTOR,N,GC TICKS/TIME: 242/245076
3307905.910,HROLL,N,done.
3307906.068,HROLL,N,Roll completed from 40.45 deg (3456) to -40.31 deg (599) took 5.7 sec 37mA (171mA peak) 23.7Vmin 499 AD/sec 229
ticks
3307906.494,HROLL,N,TRACK: b: 635/0 a: 630/0 d: 4 o: -31
3307906.609,SUSR,N,Roll to neutral...
3307906.802,HROLL,N,Roll commanded from -40.31 deg (599) to 0.00 deg (2025)...
3307907.395,HROLL,C,no progress made-35.4 deg (ad: 774) .....MOTOR_DONE: ticks: 17 max 24v: 4.6mA avg 24v: 3.8mA minV 24v: 23.8V
3307910.898,SMOTOR,N,GC TICKS/TIME: 132/135483
3307910.993,HROLL,N,done.
3307911.141,HROLL,N,Roll completed from -40.31 deg (599) to 0.03 deg (2026) took 2.8 sec 42mA (167mA peak) 23.7Vmin 514 AD/sec 111
ticks
3307911.564,HROLL,N,TRACK: b: 2000/0 a: 2006/0 d: 0 o: 20
3307911.681,SUSR,N,---- Checking VBD and valve ----
3307911.848,HVBD,N,   VBD lin pot AD counts: 620 480
3307912.002,HVBD,N,   VBD bladder position = 110.38 cc, (AD#= 550 )
3307912.277,HVBD,N,Bleed commanded from 110.63 cc (549) to -89.53 cc (1365)...
3307913.245,HVBD,N,107.9 cc (ad: 560 [636, 493]) ....................
3307924.020,HVBD,N,34.8 cc (ad: 858 [943, 781]) ....................
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3307934.795,HVBD,N,-34.8 cc (ad: 1142 [1226, 1066]) .....MOTOR_DONE: ticks: 12 max 24v: 1052.6mA avg 24v: 91.8mA minV 24v: 23.8V
3307944.303,SMOTOR,N,GC TICKS/TIME: 1250/1252199
3307944.401,HVBD,N,done.
3307944.559,HVBD,N,Bleed completed from 110.63 cc (549) to -89.78 cc (1366 [1436, 1297]) took 30.9 sec 0mA (892mA peak) 23.8Vmin 26 AD/sec 1235 ticks
3307944.968,HVBD,N,TRACK: b: 1435/1296 a: 1435/1296 d: -70 o: -69
3307945.153,HVBD,N,   VBD lin pot AD counts: 1436 1297
3307945.306,HVBD,N,   VBD bladder position = -89.78 cc, (AD#= 1366 )
3307945.439,SUSR,N,Pumping 100cc on boost alone...
3307945.683,HVBD,N,Pump commanded from -90.02 cc (1367) to 10.30 cc (958)...
3307946.664,HVBD,N,-89.5 cc (ad: 1365 [1429, 1298]) .....
3307957.439,HVBD,N,-66.5 cc (ad: 1271 [1327, 1212]) .....
3307968.214,HVBD,N,-41.9 cc (ad: 1171 [1227, 1113]) .....
3307978.989,HVBD,N,-17.2 cc (ad: 1070 [1126, 1012]) .....
3307989.789,HVBD,N,8.1 cc (ad: 967 [1022, 910]) ..MOTOR_DONE: ticks: 17 max 24v: 5.4mA avg 24v: 3.8mA minV 24v: 23.8V
3307991.399,SMOTOR,N,GC TICKS/TIME: 1797/1798868
3307991.497,HVBD,N,done.
3307991.655,HVBD,N,Pump completed from -90.02 cc (1367) to 11.28 cc (954 [1011, 897]) took 44.4 sec 109mA (2489mA peak) 23.6Vmin 9 AD/sec 1777 ticks
3307992.096,HVBD,N,TRACK: b: 1014/902 a: 1014/902 d: -56 o: -60
3307992.221,SUSR,N,Pumping up to maximum buoyancy...
3307992.472,HVBD,N,Pump commanded from 11.77 cc (952) to 110.38 cc (550)...
3307993.444,HVBD,N,12.0 cc (ad: 951 [1008, 893]) .....
3308004.194,HVBD,N,24.5 cc (ad: 900 [958, 841]) .....no progress made....
3308014.944,HVBD,N,35.3 cc (ad: 856 [915, 796]) .....
3308025.719,HVBD,N,53.7 cc (ad: 781 [842, 718]) .....
3308036.469,HVBD,N,79.2 cc (ad: 677 [740, 610]) .....
3308047.244,HVBD,N,104.7 cc (ad: 573 [638, 504]) ....MOTOR_DONE: ticks: 1 max 24v: 5.4mA avg 24v: 5.4mA minV 24v: 23.7V
3308049.932,SMOTOR,N,GC TICKS/TIME: 2267/2269030
3308050.030,HVBD,N,done.
3308050.188,HVBD,N,Pump completed from 11.53 cc (953) to 110.63 cc (549 [616, 482]) took 51.5 sec 450mA (2586mA peak) 23.3Vmin 7 AD/sec 2062 ticks
3308050.655,HVBD,N,TRACK: b: 617/484 a: 617/484 d: -67 o: -68
0.982,SSURF,N,Initializing data file
1.217,SSURF,N,Initializing log file
3.022,SUSR,N,---- Checking sensors and data file creation ----
0.174,SSURF,N,Dive started Mon Sep 10 16:02:18 2012
 (1347292938)
5.341,SUSR,N,entering SD active
6.968,SSENSOR,N,A 5322ms -0.01m 80.3 #1
9.395,SUSR,N,entering SD passive
11.007,SSENSOR,N,P 9973ms -0.04m 80.6 #2
14.591,SUSR,N,entering SD active
16.215,SSENSOR,N,A 14573ms -0.01m 80.3 #3
18.648,SUSR,N,entering SD passive
20.262,SSENSOR,N,P 19227ms -0.01m 80.2 #4
23.841,SUSR,N,entering SD active
25.467,SSENSOR,N,A 23823ms 0.03m 80.6 #5
27.892,SUSR,N,entering SD passive
29.509,SSENSOR,N,P 28471ms -0.04m 79.8 #6
33.086,SUSR,N,entering SD active
34.712,SSENSOR,N,A 33068ms -0.03m 80.3 #7
37.136,SUSR,N,entering SD passive
38.752,SSENSOR,N,P 37715ms -0.02m 80.5 #8
42.329,SUSR,N,entering SD active
43.955,SSENSOR,N,A 42311ms 0.07m 80.2 #9
46.381,SUSR,N,entering SD passive
47.996,SSENSOR,N,P 46960ms -0.04m 80.2 #10
51.573,SUSR,N,entering SD active
53.198,SSENSOR,N,A 51555ms 0.05m 80.2 #11
55.047,SUSR,N,entering SD passive
56.661,SSENSOR,N,P 55626ms -0.02m 80.1 #12
60.239,SUSR,N,entering SD active
61.865,SSENSOR,N,A 60220ms -0.02m 80.2 #13
64.288,SUSR,N,entering SD passive
65.902,SSENSOR,N,P 64868ms -0.02m 80.2 #14
69.483,SUSR,N,entering SD active
71.110,SSENSOR,N,A 69465ms -0.02m 80.4 #15
74.002,SUSR,N,---- Writing internal sensors to log ----
74.546,SUSR,N,internal humidity 1987 counts (52.436680RH)
74.764,SUSR,N,internal pressure 16.631498 psia
74.864,SUSR,N,internal pressure is high
```


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74.960,SUSR,N,---- Checking altimeter ----
75.429,HXPDR,N,ping response: R010.191ms

75.492,HXPDR,N,range was 7.643250 m
75.851,SUSR,N,---- Checking transponder ----
76.328,HXPDR,N,Tried 1 times to respond to command $C1

76.575,SUSR,N,transponder reply ping count=0
76.679,SUSR,N,---- Reporting targets and science specifications ----
79.402,SNAV,N,      Target     Latitude  Longitude    Radius Depth Finish Timeout Next target Escp target
79.749,SNAV,N,  =>  SEVEN      4807.000  -12223.000    200.0m    0  -1  0.0 SIX none
80.066,SNAV,N,      SIX        4806.000  -12222.000    200.0m    0  -1  0.0 EIGHT none
80.387,SNAV,N,      FOUR       4804.000  -12220.000    200.0m    0  -1  0.0 FIVE none
80.706,SNAV,N,      EIGHT      4808.000  -12224.000    200.0m    0  -1  0.0 KAYAKPT none
81.030,SNAV,N,      KAYAKPT    4808.000  -12223.000    100.0m    0  -1  0.0 KAYAKPT none
81.353,SNAV,N,      FIVE       4805.000  -12221.000    200.0m    0  -1  0.0 SIX none
81.804,SSENSOR,N,NOTE: 4.00 sec sample time at depth 40.0 meters is not a multiple of turn sample interval (5.00 secs).
82.121,SSENSOR,N,NOTE: 4.00 sec sample time at depth 150.0 meters is not a multiple of turn sample interval (5.00 secs).
82.371,SSENSOR,N,    Depth      Time       G&C Sensors
82.559,SSENSOR,N,    40.0m      4.0s     60.0s 111 (SBE_CT: 1)
82.807,SSENSOR,N,   150.0m      4.0s    120.0s 122 (SBE_CT: 1)
82.967,SUSR,N,---- Reporting battery status ----

86.662,SPOWER,N,------ Fuel gauges (Cumulative Amp-secs) -------

                    cumulative      / since power up
86.936,SPOWER,N,            Pitch_motor:     1.18 amp-sec /    24.18 sec
87.145,SPOWER,N,             Roll_motor:     0.83 amp-sec /    11.35 sec
87.298,SPOWER,N,    VBD_pump_during_apogee:     0.00 amp-sec /     0.00 sec
87.515,SPOWER,N,    VBD_pump_during_surface:    56.50 amp-sec /    95.97 sec
87.976,SPOWER,N,              VBD_valve:     0.00 amp-sec /     0.00 sec
88.152,SPOWER,N,     Iridium_during_init:     2.84 amp-sec /     0.00 sec
88.330,SPOWER,N,    Iridium_during_connect:     3.65 amp-sec /     0.00 sec
88.516,SPOWER,N,     Iridium_during_xfer:    59.79 amp-sec /     0.00 sec
88.712,SPOWER,N,       Transponder_ping:     0.84 amp-sec /     1.00 sec
88.864,SPOWER,N,           GUMSTIX_24V:     0.00 amp-sec /     0.00 sec
89.038,SPOWER,N,     ---------- 24V total = 0.035 AmpHr ----------
89.244,SPOWER,N,                   GPS:     2.86 amp-sec /    62.73 sec
89.457,SPOWER,N,                   TT8:     3.74 amp-sec /   114.31 sec
89.664,SPOWER,N,               LPSleep:     0.11 amp-sec /    29.12 sec
89.877,SPOWER,N,            TT8_Active:     4.91 amp-sec /   172.76 sec
90.090,SPOWER,N,          TT8_Sampling:    18.16 amp-sec /    87.80 sec
90.300,SPOWER,N,              TT8_CF8:     3.62 amp-sec /    29.15 sec
90.452,SPOWER,N,           TT8_Kalman:     0.00 amp-sec /     0.00 sec
90.663,SPOWER,N,       Analog_circuits:     4.95 amp-sec /   204.39 sec
90.815,SPOWER,N,          GPS_charging:     0.00 amp-sec /     0.00 sec
91.022,SPOWER,N,              Compass:     4.58 amp-sec /    56.06 sec
91.175,SPOWER,N,                RAFOS:     0.00 amp-sec /     0.00 sec
91.374,SPOWER,N,           Transponder:     0.43 amp-sec /     7.01 sec
91.527,SPOWER,N,             Compass2:     0.00 amp-sec /     0.00 sec
91.729,SPOWER,N,               SBE_CT:     0.47 amp-sec /     9.71 sec
91.905,SPOWER,N,     ---------- 10V total = 0.012 AmpHr ----------
92.265,HBATT,N,24V batt pack voltage = 23.75V
92.394,HBATT,N,10V batt pack voltage = 9.42V
95.762,SUSR,N,---- Checking capture vector ----
95.868,SUSR,N,all capture settings at default values
95.975,SUSR,N,---- Checking flash ----
No flash problems detected
106.984,SUSR,N,*** EOTD ***


107.748,SUSR,N,---- Checking communications ----
107.858,SUSR,N,Testing comms by transmitting self-test results:
108.322,HCF8,N,file 'st0063lu.x00' opened...
108.739,HCF8,N,file 'st0063lu.x00' has 4 KB, closed...

109.240,HCF8,N,file 'st0063lu.x01' opened...


110.433,HCF8,N,file 'st0063du.x00' opened...


111.404,SGLMALLOC,N,glheap_walk: 321288 bytes free, 9 blocks free, 35120 bytes alloc, 74 blocks alloc
```


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```
111.532,SSURF,N,Trying call 0...
111.576,SSURF,N,Calling phone number: 881600005152
115.691,HPHONE,N,initializing RUDICS connection
137.566,HPHONE,N,Iridium signal strength: 5
137.729,HPHONE,N,Iridium geolocation: 35.736984 -78.985580 Mon Sep 10 15:23:38 2012
170.636,SSURF,N,Logged in...
172.348,SSURF,N,Sending cmd lsx -k -t200 cmdfile
174.221,SSURF,N,Receiving cmdfile...
175.497,SSURF,N,SOH/STX: 0x1 received (3), secSize= 128...
177.389,SSURF,N,EOT: 0x4 received (1), secSize= 128...

177.932,SSURF,N,Received cmdfile 18 bytes
179.009,SSURF,N,Transmission succeeded...
179.093,HTT8,N,Updating parameter $T_RSLEEP to 1
179.156,SDIVE,N,Parsed command: $QUIT
179.309,HTT8,N,Writing NVRAM...done.
187.463,SUSR,N,$ID,123
187.495,SUSR,N,$MISSION,0
187.531,SUSR,N,$DIVE,0
187.565,SUSR,N,$D_SURF,3
187.602,SUSR,N,$D_FLARE,3
187.642,SUSR,N,$D_TGT,15
187.681,SUSR,N,$D_ABORT,1020
187.724,SUSR,N,$D_NO_BLEED,200
187.765,SUSR,N,$D_BOOST,0
187.804,SUSR,N,$T_BOOST,3
187.839,SUSR,N,$T_BOOST_BLACKOUT,0
187.888,SUSR,N,$D_FINISH,6
187.925,SUSR,N,$D_PITCH,0
187.960,SUSR,N,$D_SAFE,0
187.995,SUSR,N,$D_CALL,0
188.029,SUSR,N,$SURFACE_URGENCY,0
188.074,SUSR,N,$SURFACE_URGENCY_TRY,0
188.124,SUSR,N,$SURFACE_URGENCY_FORCE,0
188.179,SUSR,N,$T_DIVE,5
188.217,SUSR,N,$T_MISSION,15
188.261,SUSR,N,$T_ABORT,720
188.303,SUSR,N,$T_TURN,225
188.343,SUSR,N,$T_TURN_SAMPINT,5
188.392,SUSR,N,$T_NO_W,120
188.429,SUSR,N,$T_LOITER,0
188.466,SUSR,N,$USE_BATHY,0
188.504,SUSR,N,$USE_ICE,0
188.545,SUSR,N,$ICE_FREEZE_MARGIN,0.30000001
188.606,SUSR,N,$D_OFFGRID,100
188.650,SUSR,N,$T_WATCHDOG,10
188.690,SUSR,N,$RELAUNCH,0
188.730,SUSR,N,$APOGEE_PITCH,-5
188.776,SUSR,N,$MAX_BUOY,50
188.814,SUSR,N,$COURSE_BIAS,0
188.857,SUSR,N,$GLIDE_SLOPE,30
188.901,SUSR,N,$SPEED_FACTOR,1
188.947,SUSR,N,$RHO,1.026
188.988,SUSR,N,$MASS,52000
189.030,SUSR,N,$LENGTH,1.8
189.293,SUSR,N,$NAV_MODE,1
189.330,SUSR,N,$DIRECT_CONTROL,0
189.377,SUSR,N,$FERRY_MAX,45
189.419,SUSR,N,$KALMAN_USE,1
189.463,SUSR,N,$HD_A,0.0038360001
189.514,SUSR,N,$HD_B,0.010078
189.560,SUSR,N,$HD_C,9.8500004e-06
189.609,SUSR,N,$HEADING,-1
189.645,SUSR,N,$ESCAPE_HEADING,0
189.693,SUSR,N,$ESCAPE_HEADING_DELTA,10
189.745,SUSR,N,$FIX_MISSING_TIMEOUT,0
189.800,SUSR,N,$TGT_DEFAULT_LAT,4212
189.854,SUSR,N,$TGT_DEFAULT_LON,-7043
189.904,SUSR,N,$TGT_AUTO_DEFAULT,0
189.953,SUSR,N,$SM_CC,800
189.992,SUSR,N,$N_FILEKB,4
190.028,SUSR,N,$FILEMGR,0
190.067,SUSR,N,$CALL_NDIVES,1
```


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190.107,SUSR,N,$COMM_SEQ,0
190.144,SUSR,N,$KERMIT,0
190.181,SUSR,N,$N_NOCOMM,1
190.218,SUSR,N,$N_NOSURFACE,0
190.260,SUSR,N,$UPLOAD_DIVES_MAX,-1
190.311,SUSR,N,$CALL_TRIES,5
190.353,SUSR,N,$CALL_WAIT,60
190.395,SUSR,N,$CAPUPLOAD,1
190.436,SUSR,N,$CAPMAXSIZE,100000
190.481,SUSR,N,$HEAPDBG,0
190.521,SUSR,N,$T_GPS,15
190.558,SUSR,N,$N_GPS,20
190.593,SUSR,N,$T_GPS_ALMANAC,0
190.641,SUSR,N,$T_GPS_CHARGE,-20734.646
190.696,SUSR,N,$T_RSLEEP,1
190.733,SUSR,N,$STROBE,0
190.770,SUSR,N,$RAFOS_PEAK_OFFSET,1.5
190.823,SUSR,N,$RAFOS_CORR_THRESH,60
190.877,SUSR,N,$RAFOS_HIT_WINDOW,3600
190.930,SUSR,N,$PITCH_MIN,600
190.976,SUSR,N,$PITCH_MAX,3300
191.022,SUSR,N,$C_PITCH,2700
191.068,SUSR,N,$PITCH_DBAND,0.0099999998
191.127,SUSR,N,$PITCH_CNV,0.003125763
191.182,SUSR,N,$P_OVSHOOT,0.039999999
191.235,SUSR,N,$PITCH_GAIN,30
191.281,SUSR,N,$PITCH_TIMEOUT,16
191.329,SUSR,N,$PITCH_AD_RATE,175
191.376,SUSR,N,$PITCH_MAXERRORS,1
191.421,SUSR,N,$PITCH_ADJ_GAIN,0
191.465,SUSR,N,$PITCH_ADJ_DBAND,0
191.513,SUSR,N,$ROLL_MIN,300
191.556,SUSR,N,$ROLL_MAX,3750
191.600,SUSR,N,$ROLL_DEG,40
191.644,SUSR,N,$C_ROLL_DIVE,2025
191.693,SUSR,N,$C_ROLL_CLIMB,2025
191.742,SUSR,N,$HEAD_ERRBAND,10
191.790,SUSR,N,$ROLL_CNV,0.028270001
191.842,SUSR,N,$ROLL_TIMEOUT,15
191.890,SUSR,N,$R_PORT_OVSHOOT,24
191.939,SUSR,N,$R_STBD_OVSHOOT,19
191.987,SUSR,N,$ROLL_AD_RATE,350
192.034,SUSR,N,$ROLL_MAXERRORS,1
192.078,SUSR,N,$ROLL_ADJ_GAIN,0
192.120,SUSR,N,$ROLL_ADJ_DBAND,0
192.167,SUSR,N,$ROLL_GAIN_P,0.5
192.214,SUSR,N,$VBD_MIN,550
192.452,SUSR,N,$VBD_MAX,3500
192.494,SUSR,N,$C_VBD,1000
192.534,SUSR,N,$VBD_DBAND,2
192.578,SUSR,N,$VBD_CNV,-0.245296
192.628,SUSR,N,$VBD_TIMEOUT,720
192.676,SUSR,N,$PITCH_VBD_SHIFT,4.9999999e-05
192.739,SUSR,N,$VBD_PUMP_AD_RATE_SURFACE,5
192.797,SUSR,N,$VBD_PUMP_AD_RATE_APOGEE,4
192.855,SUSR,N,$VBD_BLEED_AD_RATE,8
192.905,SUSR,N,$UNCOM_BLEED,60
192.949,SUSR,N,$VBD_MAXERRORS,1
192.995,SUSR,N,$CF8_MAXERRORS,20
193.043,SUSR,N,$AH0_24V,145
193.085,SUSR,N,$AH0_10V,95
193.125,SUSR,N,$MINV_24V,19
193.166,SUSR,N,$MINV_10V,8
193.203,SUSR,N,$FG_AHR_10V,0
193.242,SUSR,N,$FG_AHR_24V,0
193.284,SUSR,N,$PHONE_SUPPLY,2
193.331,SUSR,N,$PRESSURE_YINT,-46.17355
193.389,SUSR,N,$PRESSURE_SLOPE,0.0001159254
193.451,SUSR,N,$AD7714Ch0Gain,128
193.496,SUSR,N,$TCM_PITCH_OFFSET,0
193.542,SUSR,N,$TCM_ROLL_OFFSET,0
193.593,SUSR,N,$COMPASS_USE,641
193.635,SUSR,N,$ALTIM_BOTTOM_PING_RANGE,0

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```
193.690,SUSR,N,$ALTIM_TOP_PING_RANGE,0
193.746,SUSR,N,$ALTIM_BOTTOM_TURN_MARGIN,12
193.803,SUSR,N,$ALTIM_TOP_TURN_MARGIN,0
193.857,SUSR,N,$ALTIM_TOP_MIN_OBSTACLE,1
193.914,SUSR,N,$ALTIM_PING_DEPTH,80
193.964,SUSR,N,$ALTIM_PING_DELTA,5
194.016,SUSR,N,$ALTIM_FREQUENCY,13
194.065,SUSR,N,$ALTIM_PULSE,3
194.108,SUSR,N,$ALTIM_SENSITIVITY,2
194.158,SUSR,N,$XPDR_VALID,2
194.201,SUSR,N,$XPDR_INHIBIT,90
194.249,SUSR,N,$INT_PRESSURE_SLOPE,0.0097660003
194.311,SUSR,N,$INT_PRESSURE_YINT,0
194.358,SUSR,N,$DEEPGLIDER,0
194.397,SUSR,N,$DEEPGLIDERMB,0
194.441,SUSR,N,$MOTHERBOARD,4
194.485,SUSR,N,$DEVICE1,2
194.526,SUSR,N,$DEVICE1INSTANCE,1234
194.577,SUSR,N,$DEVICE2,-1
194.617,SUSR,N,$DEVICE2INSTANCE,1
194.664,SUSR,N,$DEVICE3,-1
194.704,SUSR,N,$DEVICE3INSTANCE,-1
194.753,SUSR,N,$DEVICE4,-1
194.792,SUSR,N,$DEVICE4INSTANCE,-1
194.841,SUSR,N,$DEVICE5,-1
194.881,SUSR,N,$DEVICE5INSTANCE,-1
194.929,SUSR,N,$DEVICE6,-1
194.969,SUSR,N,$DEVICE6INSTANCE,-1
195.018,SUSR,N,$LOGGERS,7
195.056,SUSR,N,$LOGGERDEVICE1,-1
195.103,SUSR,N,$LOGGERDEVICE2,-1
195.149,SUSR,N,$LOGGERDEVICE3,-1
195.196,SUSR,N,$LOGGERDEVICE4,-1
195.245,SUSR,N,$COMPASS_DEVICE,33
195.293,SUSR,N,$COMPASS2_DEVICE,-1
195.345,SUSR,N,$PHONE_DEVICE,48
195.617,SUSR,N,$GPS_DEVICE,32
195.660,SUSR,N,$RAFOS_DEVICE,-1
195.708,SUSR,N,$XPDR_DEVICE,24
195.750,SUSR,N,$SIM_W,0
195.787,SUSR,N,$SIM_PITCH,-20
195.833,SUSR,N,$SEABIRD_T_G,0.0043000001
195.892,SUSR,N,$SEABIRD_T_H,0.00063999998
195.952,SUSR,N,$SEABIRD_T_I,2.4999999e-05
196.012,SUSR,N,$SEABIRD_T_J,4.3e-06
196.063,SUSR,N,$SEABIRD_C_G,-10
196.108,SUSR,N,$SEABIRD_C_H,1
196.153,SUSR,N,$SEABIRD_C_I,-0.0020000001
196.214,SUSR,N,$SEABIRD_C_J,0.00019999999
196.271,SUSR,N,$EBE_ENABLE,1
196.313,SUSR,N,$GC_WINDOW,2
196.354,SUSR,N,$GC_LAST_COLLECTION,2
198.088,SSURF,N,Sending cmd lsx -k -t200 targets
208.165,SSURF,N,No targets file on basestation [lsx -k -t200 targets
sg123= ]
212.029,SSURF,N,Sending cmd lsx -k -t200 science
222.105,SSURF,N,No science file on basestation [lsx -k -t200 science
sg123= ]
222.292,SSENSOR,N,NOTE: 4.00 sec sample time at depth 40.0 meters is not a multiple of turn sample interval (5.00 secs).
222.454,SSENSOR,N,NOTE: 4.00 sec sample time at depth 150.0 meters is not a multiple of turn sample interval (5.00 secs).
224.268,SSURF,N,Sending cmd lsx -k -t200 pdoscmds.bat
234.355,SSURF,N,No pdoscmds.bat file on basestation [lsx -k -t200 pdoscmds.bat
sg123= ]
234.574,SSURF,N,Sending cmd lrx -y -c -t200 st0063lu.x00
236.358,SSURF,N,Sending st0063lu.x00...
236.459,SSURF,N,block: 1, size: 1024, blkSize: 1024, attempt: 1...
242.357,SSURF,N,block: 2, size: 1024, blkSize: 1024, attempt: 1...
248.205,SSURF,N,block: 3, size: 1024, blkSize: 1024, attempt: 1...
254.055,SSURF,N,block: 4, size: 1024, blkSize: 1024, attempt: 1...
259.829,SSURF,N,EOT sent ...
265.044,SSURF,N,recieved ACK (attempt 0)
266.575,SSURF,N,Transmission succeeded...
266.676,SSURF,N,Sending cmd lrx -y -c -t200 st0063lu.x01
```


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```
268.404,SSURF,N,Sending st0063lu.x01...
268.486,SSURF,N,block: 1, size: 293, blkSize: 1024, attempt: 1...
274.409,SSURF,N,EOT sent ...
279.623,SSURF,N,recieved ACK (attempt 0)
281.246,SSURF,N,Transmission succeeded...
281.348,SSURF,N,Sending cmd lrx -y -c -t200 st0063du.x00
283.072,SSURF,N,Sending st0063du.x00...
283.158,SSURF,N,block: 1, size: 675, blkSize: 1024, attempt: 1...
289.255,SSURF,N,EOT sent ...
294.470,SSURF,N,recieved ACK (attempt 0)
296.006,SSURF,N,Transmission succeeded...
Compressing THISDIVE.KAP to st0063kz.x...
299.269,SSURF,N,Sending cmd lrx -y -c -t200 st0063kz.x
300.977,SSURF,N,Sending st0063kz.x...
301.114,SSURF,N,block: 1, size: 1024, blkSize: 1024, attempt: 1...
307.163,SSURF,N,block: 2, size: 1024, blkSize: 1024, attempt: 1...
313.011,SSURF,N,block: 3, size: 1024, blkSize: 1024, attempt: 1...
318.863,SSURF,N,block: 4, size: 1024, blkSize: 1024, attempt: 1...
324.803,SSURF,N,block: 5, size: 1024, blkSize: 1024, attempt: 1...
330.743,SSURF,N,block: 6, size: 1024, blkSize: 1024, attempt: 1...
336.682,SSURF,N,block: 7, size: 1024, blkSize: 1024, attempt: 1...
342.621,SSURF,N,block: 8, size: 1024, blkSize: 1024, attempt: 1...
350.367,SSURF,N,block: 9, size: 1024, blkSize: 1024, attempt: 1...
356.216,SSURF,N,block: 10, size: 403, blkSize: 1024, attempt: 1...
362.073,SSURF,N,EOT sent ...
367.375,SSURF,N,recieved ACK (attempt 0)
370.823,SSURF,N,Transmission succeeded...

372.418,SSURF,N,logout...
382.482,SPOWER,N,powerOFF (7,Iridium_during_xfer) without corresponding powerON!
382.586,SSURF,N,Total NAK's: 0, timeouts: 0
382.764,SGLMALLOC,N,glheap_walk: 321180 bytes free, 12 blocks free, 35180 bytes alloc, 73 blocks alloc
382.943,SUSR,N,---- Self test FAILED or ABORTED! ----
383.051,SUSR,N,1 failures noted
383.129,SUSR,N,--> bathymetry maps failed
383.321,SUSR,N,Restoring original settings...

------ Launch Menu ------
    1 [scene   ]  Set scenario mode
    2 [selftest]  Perform interactive self test
    3 [autotest]  Perform autonomous self test
    4 [uploadst]  Upload self-test results
    5 [reset   ]  Reset dive/run number
    6 [test    ]  Test Launch!
    7 [sea     ]  Sea Launch!
   CR)  Return to previous
Enter selection (1-7,CR): Timed out. Going to sleep. Try a BREAK to wake.
```


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APPENDIX F

Hardware and Configuration Menus

There are a number of functional checks of, and changes to, configuration that you can do when directly connected to the 1KA Seaglider via the communication cable. All actions areFfound under the Main menu. The following figures show the content of each submenu of the Main menu with a brief description.

NOTE: These menus can also be accessed through the pdoscmds.bat file which is uploaded by Seaglider when it calls into the basestation. For information on how to use the pdoscmds.bat file method, see the Appendix C, “Extended PicoDOS® Reference Manual, v66.07” on page 233.

Main menu

The Main menu is characteristic of all menus on the Seaglider vehicle (Figure F-1).

```
------ Main Menu ------
     1 [param   ]  Parameters and configuration
     2 [hw      ]  Hardware tests and monitoring
     3 [modes   ]  Test operation modes and files
     4 [pdos    ]  PicoDOS commands (and exit)
     5 [launch  ]  Pre-launch
```

Figure F-1. Main menu

Make selections numerically or by typing the name of the shortcut inside the [ ]. The advantage to using names instead of numbers is that names do not typically change when the menu items are rearranged or items are added when the software version changes. Using names also facilitates navigating multiple menus with a single command.

Access submenus

- Enter the number preceding the parameter name, and press Enter.

  or

- Add a / (slash) and the name of the submenu.

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For example, from the top-level menu, it is possible to do a compass self-test by typing the following text at the Main menu prompt:

Enter selection (1-5,CR): `hw/compass/selftest`

Navigating one menu at a time requires typing `hw` (or the number `2`), which then displays the Hardware Test menu. At the Hardware menu prompt, type `compass` (or the number `6`) to display the compass menu. Finally, type `selftest` (or the number `1`) to run the actual selftest. This works at any level of the menu tree. If you are already at the Hardware menu, typing `compass/selftest` runs the selftest item from the compass submenu.

You can display the entire menu structure by typing `help` at the main menu prompt. Typing `help` at any prompt displays the menu structure below that point in the menu tree. Typing `help search` will display all menu entries below that point in the tree containing the word search in their names or labels.

Many menu system functions require additional user input. These inputs can generally be provided as either arguments to the selection command entered at the menu prompt or as answers to separate questions asked once the function is selected. For example, if you select the following pressure sensor self test, you are prompted to answer yes or no about whether the glider is at sea level.

Enter selection (1-5,CR): `hw/pressure/selftest`

Alternatively, you could provide this information at the menu prompt as follows:

Enter selection (1-5,CR): `hw/pressure/selftest sealevel=1`

In this case `sea level=1` indicates that the glider is at sea level. A value of 0 would indicate the negative response.

Using optional arguments to the menu selection prompt is the only way to provide information to menu functions when using the menu system noninteractively via extended PicoDOS. You access functions in the menu tree via extended PicoDOS by using the `menu` command:

```
picoDOS >> menu hw/pressure/selftest sea level=1
```

Using the pdoscmds.bat provides a powerful mechanism for accessing test functionality while the Seaglider vehicleis operating in the field.

In addition to menu selections, you can also execute extended PicoDOS commands and parameter changes at any menu prompt. PicoDOS commands are preceded by an ! (exclamation mark). For example, typing the following command displays the directory of the compact flash card:

Enter selection (1-5,CR): `!dir`

You can also reach the extended PicoDOS prompt (`picoDOS>>`) from any menu by typing `pdos`. Parameters can be viewed or changed simply by typing their full name preceded by a $ (dollar sign):

The following command displays the value of **$T_DIVE**:

Enter selection (1-5,CR): `$T_DIVE`

The following command changes the value of **$T_DIVE** to 30.

Enter selection (1-5,CR): `$T_DIVE,30`

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Parameters and Configuration menu

View the Parameters and Configuration menu

- Select **1 Basic mission and glider parameters**, and press Enter (Figure F-2).

```
------ Edit parameters ------
*Flight control and mission definition
     1 [basic    ]  Basic mission and glider parameters
     2 [dive     ]  Dive parameters
     3 [flight   ]  Flight parameters
     4 [surface  ]  Surface parameters
     5 [rafos    ]  RAFOS parameters
     6 [password]   Set/show glider login password
     7 [telnum   ]  Set/show basestation phone number
     8 [altnum   ]  Set/show basestation alternate phone number
*Pitch, roll, VBD
     9 [pitch    ]  Pitch parameters
    10 [roll     ]  Roll parameters
    11 [vbd      ]  VBD parameters
*Sensors and peripherals
    12 [config   ]  Hardware configuration parameters
    13 [pressure]   Pressure (external) parameters
    14 [intpress]   Pressure (internal) parameters
    15 [compass  ]  Compass paramaters
    16 [altim    ]  Altimetry parameters
    17 [seabird  ]  Seabird CT calibration
    18 [power    ]  Power parameters
*Utility
    19 [all      ]  Edit all parameters
    20 [validate]   Validate parameters
    21 [details  ]  Show parameter details
    22 [show     ]  Show changed parameters
    23 [clear    ]  Clear changed parameters
    24 [save     ]  Save parameters by name to file
    25 [dump     ]  Dump parameters to screen
    26 [load     ]  Load parameters from file
    27 [reset    ]  Reset to defaults
    CR)  Return to previous
```

Figure F-2. Parameters and Configuration menu

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Basic Mission and Seaglider Parameters menu

View the Basic Mission and Seaglider Parameters menu

- Select **1**: **Basic Mission and Seaglider Parameters**, and press Enter.

  The current value for each parameter is in brackets to the right of the parameter name (Figure F-3). For an explanation of each parameter and the acceptable range of values, see Chapter 5, “Piloting Parameters” on page 47.

```
Enter selection (1-27,CR): 1
------ Basic (current value in [])-------
     1) $ID [506] Glider ID (3 digits max)
     2) $MISSION [2] Current mission number
     3) $T_WATCHDOG [10] Watchdog timer (min)
     4) $RELAUNCH [0] Relaunch glider if crash to TOM8?
        (0=no/1=yes)
     5) $HEAPDBG [0] In depth heap debugging  (0=off/1=on)
     6) $CF8_MAXERRORS [20] Number of CF8 errors allowed before
        entering recovery
    CR) Return to previous menu
```

Figure F-3. Basic Mission and Seaglider Parameters menu

Change the value for a parameter

1. Enter the number preceding the parameter name, and press Enter.
2. When prompted, type the value, and press Enter.
3. To return to the Parameters and Configuration menu, press Enter.

Example

If the mission number must be edited from 2 to 3, select **2**: **$MISSION,** and press Enter.

Seaglider displays the following response:

```
New value? [2.00]  Press ENTER if correct.
```

The user is returned to the Basic Mission and Seaglider Parameters menu.

If the value is incorrect, Seaglider displays the following response:

```
New value? [2.00]  type 3 and press ENTER
```

Seaglider acknowledges the update and you are returned to the Basic Mission and Seaglider Parameters menu (Figure F-4).

```
$MISSION,
New value? [2.00] 3
1373.601,HTT8,N,Updating parameter $MISSION to 3
```

Figure F-4. Checking or changing the Seaglider mission number

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Dive parameters

1. From the Parameters and Configuration menu, select **2**: **Dive parameters**, and press Enter (Figure F-5).

```
------ Dive (current value in [])-------
     1) $DIVE [9] Next dive number
     2) $D_FLARE [3] Flare depth (m)
     3) $D_TGT [10] Target depth (m)
     4) $D_ABORT [1090] Abort depth (m)
     5) $D_NO_BLEED [500] Depth below which we will not bleed on dives (m)
     6) $D_BOOST [0] Depth above which only boost pump is run (m)
     7) $T_BOOST [0] Time to run the boost pump before turning off (0 do not turn off)
     8) $T_DIVE [15] Target time per dive/climb cycle (min)
     9) $T_MISSION [15] Maximum mission time per dive/climb cycle (min)
    10) $T_ABORT [1440] Failsafe watchdog  mission time - change with extreme care (min)
    11) $T_TURN [225] Max time allowed for a turn maneuver (sec)
    12) $T_TURN_SAMPINT [4] Sample interval during a turn (int sec, >=4)
    13) $T_NO_W [60] Time with no vertical velocity (w) before taking next step (secs)
    14) $T_LOITER [0] Time to loiter at apogee before climbing (secs)
    15) $USE_BATHY [-1] Use bathymetry map (0 - no, +/-nnn - file number)
    16) $D_OFFGRID [100] Max target depth if outside bathymap (m)
    17) $SIM_W [0.1] Simulated W (m/s) 0 - use pressure gauge to compute depth
    18) $SIM_PITCH [-20] Simulated dive pitch (e.g., -20 degrees) 0 - use TCM2 to report pitch
    CR) Return to previous menu
Enter selection (1-18,CR):
```

Figure F-5. Dive Parameters menu

2. To edit a parameter value, follow the procedures under"Basic Mission and Seaglider Parameters menu"

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Flight parameters

1. From the Parameters and Configuration menu, select **3**: **Flight parameters** and press Enter (Figure F-6).

```
------ Flight (current value in [])-------
     1) $D_SAFE [0] Safety dive depth for emergency/escape maneuvers
        (m)
     2) $APOGEE_PITCH [-8] Intermediate pitch angle @ apogee (deg)
     3) $MAX_BUOY [220] Max buoyancy force allowed @ apogee (g)
     4) $COURSE_BIAS [0] Course bias to subtract from the computed
        (deg, +cw)
     5) $GLIDE_SLOPE [30] Max glide slope allowed (deg)
     6) $SPEED_FACTOR [1] Fudge factor for glider speed
     7) $RHO [1.0233001] Water density (grams/cc)
     8) $MASS [51509] Glider mass (g)
     9) $NAV_MODE [1] Navigation mode (0=direct/1=Kalman/2=Set
        correct/3=Current relative)
    10) $FERRY_MAX [45] Ferry angle bound for set correction navigation
        (deg)
    11) $KALMAN_USE [2] Kalman filter (0=reset/1=enable/2=skip)
    12) $HD_A [0.003] Glider hydrodynamic lift (A)
    13) $HD_B [0.0099999998] Glider hydrodynamic drag (B)
    14) $HD_C [9.9999997e-06] Glider hydrodynamic induced drag (C)
    15) $HEADING [-1] Heading (degrees true) to steer (-1 disable)
    16) $ESCAPE_HEADING [0] Escape heading (degrees magnetic) to steer
        in emergency
    17) $ESCAPE_HEADING_DELTA [10] Escape heading offset (degrees) in
        emergency
    18) $FIX_MISSING_TIMEOUT [0] Time (days) without fix before
        activating escape heading
    19) $TGT_DEFAULT_LAT [4808] Default target latitude
    20) $TGT_DEFAULT_LON [-12223] Default target longitude
    21) $TGT_AUTO_DEFAULT [0] Automatically update default target
    CR) Return to previous menu
Enter selection (1-21,CR):
```

Figure F-6. Flight Parameters menu

2. To edit a parameter value, follow the procedures under"Basic Mission and Seaglider Parameters menu"

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Surface parameters

1. From the Parameters and Configuration menu, select **4**: **Surface parameters,** and press Enter (Figure F-7).

```
------ Parameters (current value in [])-------
     1) $D_SURF [4] Surface depth (m)
     2) $D_FINISH [10] Dive finish depth (m)
     3) $D_PITCH [0] Depth to achieve before surface maneuver pitch (m)
     4) $D_CALL [0] Depth to achieve before antenna is assumed to be
        out of water (m)
     5) $SURFACE_URGENCY [0] Number of dives to accumulate before
        trying extra surfacings
     6) $SURFACE_URGENCY_TRY [0] Dive number modulo for extra surfacing
        attempts
     7) $SURFACE_URGENCY_FORCE [0] Dive number modulo for forced extra
        surfacing attempts
     8) $USE_ICE [0] Use ice map for surfacing decisions (0 - no, +/-
        nnn - file number)
     9) $ICE_FREEZE_MARGIN [0.30000001] Margin (degC) in freezing point
        check for surfacing
    10) $SM_CC [520] VBD volume for surfacing (cc)
    11) $N_FILEKB [4] File segment size for upload (KBytes <=16, 0=no
        split, negative=no gzip)
    12) $FILEMGR [0] File management aggressiveness: 0=none, 1=only
        store compressed, 2=delete splits on failed phone call
    13) $CALL_NDIVES [1] # of dive/climb cycles before calling
    14) $COMM_SEQ [0] Comm sequence to use (0-default, 1-ctl only, 2-no
        loggers)
    15) $KERMIT [0] Use of kermit (0 - none, 1 - data only, 2 - data
        only, batch, 3 data and control, 4 data and control - data
        batch)
    16) $N_NOCOMM [1] # dives without communications before max surface
    17) $N_NOSURFACE [0] modulo for dives to finish under surface
    18) $UPLOAD_DIVES_MAX [-1] maximum # of dives to upload at each
        surfacing (-1 = all available)
    19) $CALL_TRIES [5] # of calls to try at each surfacing
    20) $CALL_WAIT [60] Delay between phone tries (sec)
    21) $CAPUPLOAD [1] Upload capture file (0=no/1=yes)
    22) $CAPMAXSIZE [200000] Maximum capture file size to upload
        (before compression)
    23) $T_GPS [15] GPS timeout (min)
    24) $N_GPS [20] Max # valid GPS readings
    25) $T_GPS_ALMANAC [0] Time to wait to reacquire the GPS almanac
        (mins)
    26) $T_GPS_CHARGE [-10258.504] How long to trickle charge the GPS
        (secs)
    27) $T_RSLEEP [3] Sleep interval during recovery (min)
    28) $STROBE [0] Strobe control (0=never, 1=recovery, 2=surface)
    CR) Return to previous menu
    Enter selection (1-28,CR
```

Figure F-7. Surface Parameters menu

2. To edit a parameter value, follow the procedures under"Basic Mission and Seaglider Parameters menu"

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RAFOS parameters

1. From the Parameters and Configuration menu, select **5**: **RAFOS parameters,** and press Enter (Figure F-8).

   NOTE: RAFOS is not licensed to iRobot and as such, while these parameters do appear in parameter lists, they are NOT activated in the iRobot version of 1KA Seaglider software.

```
------ Parameters (current value in [])-------
        1) $RAFOS_PEAK_OFFSET [1.5] internal delay of RAFOS receiver
           (seconds)
        2) $RAFOS_CORR_THRESH [60] threshold correlation value for hits
           used in navigation
        3) $RAFOS_HIT_WINDOW [3600] window length (seconds) in which to
           search for hits to use in navigation
   CR) Return to previous menu
Enter selection (1-3,CR):
```

   Figure F-8. RAFOS Parameters menu

2. To return to the Parameters and Configuration menu, press Enter.

Password

The password assigned to a Seaglider at the factory is 6 digits long. The first three digits are the ID number for the Seaglider vehicle. The last three digits are either 680 if ID is even, or 791 if the ID is odd.

However, passwords can be any alphanumeric string, up to 15 characters long. Passwords cannot contain punctuation or special characters. The password must be the same on the Seaglider vehicle and its basestation.

1. To access the current password, from the Parameters and Configuration menu, select **6**: **Password,** and press Enter (Figure F-9).

```
6477.808,SUSR,N,Current password is 506680
New password (15 char max length, CR to leave unchanged): |
```

   Figure F-9. Verify the Seaglider password

2. Verify the password:
   - If the password is correct, press Enter.

     The Parameters and Configuration menu is displayed.
   - If the password is incorrect, enter the correct password and press Enter.

     Seaglider acknowledges the update and the Parameters and Configuration menu is displayed.

   If there are any questions contact iRobot Customer Support. A Seaglider cannot call in to the basestation unless the password is the same on both the basestation and Seaglider.

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Telnum

Telephone numbers can be no more than 15 digits long. For more information, see Chapter 3, “Setting Up the System” on page 7.

1. To access the current basestation telephone number, from the Parameters and Configuration menu, select **7**: **Telnum,** and press Enter (Figure F-10).

```
6561.080,SUSR,N,Current telnum is 12062215341
New telnum (15 char max length, CR to leave unchanged):
    19194841429
6605.038,SUSR,N,Changing telnum to 19194841429
```

Figure F-10. Verify the basestation telephone number in Seaglider

2. Verify the telephone number:
   - If the telephone number is correct press Enter.

     The user is returned to the Parameters and Configuration menu.
   - If the telephone number is incorrect type the correct number and press Enter.

     Seaglider acknowledges the update and the Parameters and Configuration menu is displayed.

Altnum

1. To access the alternate basestation telephone number, from the Parameters and Configuration menu, select **8**: **Altnum,** and press Enter (Figure F-11).

```
6699.777,SUSR,N,Current altnum is 12062217301
New altnum (15 char max length, CR to leave unchanged):
19193612847
6725.312,SUSR,N,Changing altnum to 19193612847
```

Figure F-11. Verify the basestation alternate telephone number in Seaglider

2. To edit a parameter value, follow the procedures in“Telnum”.

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Pitch parameters

1. From the Parameters and Configuration menu, select **9**: **Pitch parameters**, and press Enter (Figure F-12).

   The current value for each parameter is in brackets to the right of the parameter name.

```
------ Pitch (current value in [])-------
        1) $PITCH_MIN [160 (-9.4 cm)] Pitch position limit, fwd (AD#)
        2) $PITCH_MAX [3940 (2.4 cm)] Pitch position limit, aft (AD#)
        3) $C_PITCH [3180] Pitch neutral point, (AD#)
        4) $PITCH_DBAND [+/- 0.10] Pitch position deadband (cm)
        5) $PITCH_CNV [0.003125763] Pitch position conversion factor
           (cm/AD#)
        6) $P_OVSHOOT [0.039999999] Pitch mass overshoot after motor off
           (cm)
        7) $PITCH_GAIN [26] Pitch angle to mass gain (deg/cm)
        8) $PITCH_TIMEOUT [17] Pitch mass timeout (sec)
        9) $PITCH_AD_RATE [175] Pitch motor AD counts per sec
        10)$PITCH_MAXERRORS [1] Number of pitch errors allowed before
           entering recovery
        11) $PITCH_ADJ_GAIN [0] Gain for auto-adjusting pitch (cm/deg)
        12) $PITCH_ADJ_DBAND [0] Deadband for auto-adjusting pitch (deg)
        CR) Return to previous menu
Enter selection (1-12,CR):
```

   Figure F-12. Pitch Parameters menu

   For a description and acceptable range of values for each parameter, see Chapter 5, “Piloting Parameters” on page 47.

   For the exact values of **$PITCH_MIN**, **$PITCH_MAX,** and **$C_PITCH**, see the trim sheets in the notebook shipped with the Seaglider vehicle.

2. To change a parameter value, follow the procedures under “Basic Mission and Seaglider Parameters menu”.

Roll parameters

1. From the Parameters and Configuration menu, select **10**: **Roll Parameters,** and press Enter (Figure F-13).

```
------ Roll (current value in [])-------
  1) $ROLL_MIN [180 (-59.6 deg)] Roll position limit, port (AD#)
  2) $ROLL_MAX [3875 (44.8 deg)] Roll position limit, stbd (AD#)
  3) $ROLL_DEG [45] Roll position normal flight (deg)
  4) $C_ROLL_DIVE [2290] Roll neutral point when diving and testing,
     (AD#)
  5) $C_ROLL_CLIMB [2090] Roll neutral point when climbing, (AD#)
  6) $HEAD_ERRBAND [+/- 10.00] Roll (scene)/Heading (auto)
     deadband,(deg)
  7) $ROLL_CNV [0.028270001] Roll position conversion factor
     (deg/AD#)
  8) $ROLL_TIMEOUT [15] Roll mass timeout, (roll and rollback, sec)
  9) $R_PORT_OVSHOOT [18] Roll mass overshoot to port after motor
     off (AD)
 10) $R_STBD_OVSHOOT [28] Roll mass overshoot to stbd after motor
     off (AD)
 11) $ROLL_AD_RATE [400] Roll motor AD count per sec
 12) $ROLL_MAXERRORS [1] Number of roll errors allowed before
     entering recovery
 13) $ROLL_ADJ_GAIN [1.5] Gain for auto-adjusting roll center (deg
     battery roll / deg/sec turn rate
 14) $ROLL_ADJ_DBAND [0.025] Deadband for auto-adjusting roll center
     (deg/sec)
 CR) Return to previous menu
```

   Figure F-13. Roll Parameters menu

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For a description and acceptable range of values for each parameter, see Chapter 5, “Piloting Parameters” on page 47.

For the exact values of **$ROLL_MIN**, **$ROLL_MAX,** and **$C_ROLL**, see the trim sheets in the notebook shipped with the Seaglider vehicle.

2. To change a parameter value, follow the procedures under “Basic Mission and Seaglider Parameters menu”.

VBD parameters

1. From the Parameters and Configuration menu, select **11**: **VBD parameters,** and press Enter (Figure F-14).

```
------ VBD (current value in [])-------
        1) $VBD_MIN [430 (654.9 cc)] VBD bladder position limit, minimum
           (AD$)
        2) $VBD_MAX [3959 (-210.7 cc)] VBD bladder position limit,
           maximum (AD$)
        3) $C_VBD [3100] VBD bladder neutral point, (AD$)
        4) $VBD_DBAND [+/- 2.00] VBD bladder position deadband (cc)
        5) $VBD_CNV [-0.245296] VBD bladder position conversion factor
           (cc/AD$)
        6) $VBD_TIMEOUT [720] VBD timeout (sec)
        7) $PITCH_VBD_SHIFT [0.0012300001] Pitch offset due to VBD
           (cm/cc)
        8) $VBD_PUMP_AD_RATE_SURFACE [5] VBD pump AD counts per sec at
           surface
        9) $VBD_PUMP_AD_RATE_APOGEE [4] VBD pump AD counts per sec at
           apogee
       10) $VBD_BLEED_AD_RATE [8] VBD bleed AD counts per sec at surface
       11) $UNCOM_BLEED [50] Uncommanded bleed change (AD) 0 - disabled
       12) $VBD_MAXERRORS [1] Number of VBD errors allowed before
           entering recovery
    ?R) Return to previous menu
```

Figure F-14. VBD Parameters menu

For a description and acceptable range of values for each parameter, see Chapter 5, “Piloting Parameters” on page 47.

For the exact values of **$VBD_MIN**, **$VBD_MAX,** and **$C_VBD,** see the trim sheets in the notebook shipped with the Seaglider vehicle.

2. To change a parameter value, follow the procedures in “Basic Mission and Seaglider Parameters menu” on page 282.

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Hardware configuration parameters

Seaglider hardware configuration is done at the factory. It is not recommended that the user change any of the values in this menu without consulting iRobot Customer Service.

1. From the Parameters and Configuration menu, select **12**: **Hardware configuration parameters** and press Enter (Figure F-15).

```
------ Edit hardware configuration parameters ------
     1 [show    ]  Show current hardware configuration
     2 [motherbo]  Configure motherboard
     3 [compass ]  Configure compass
     4 [compass2]  Configure spare compass
     5 [phone   ]  Configure phone
     6 [gps     ]  Configure GPS
     7 [xpdr    ]  Configure XPDR
     8 [sensor  ]  Configure sensor
     9 [logger  ]  Configure logger sensor
    10 [add     ]  Add device file to hardware library
    11 [logdev  ]  Add logger file to hardware library
    12 [pressure]  Configure external pressure sensor
    13 [param   ]  Edit parameters directly
    CR)  Return to previous
```

Figure F-15. Hardware Configuration Parameters menu

2. To return to the Parameters and Configuration menu, press Enter.

   Seaglider responds with the following command:

```
Re-initialize hardware configuration [N]
```

3. Type `[N]` unless hardware configuration changes were made with the approval of iRobot.

Pressure (external) parameters

Initial setup of the External Pressure parameters is done at the factory. The **$Pressure_YINT** parameter is updated by Seaglider during selftest. It is not recommended that the user change any of the values in this menu without consulting iRobot Customer Service.

1. From the Parameters and Configuration menu, select **13**: **Pressure (external) parameters,** and press Enter (Figure F-16).

   The current value for each parameter is in brackets to the right of the parameter name.

```
------ Pressure (current value in [])-------
     1) $PRESSURE_YINT [-43.606201] Pressure, Y-intercept (psig)
     2) $PRESSURE_SLOPE [0.00011645618] Pressure, slope
        (psig/AD$)
     3) $AD7714Ch0Gain [128] AD7714 pressure chan gain
        (1=simulation/64=Druck 4020/128=Paine)
    CR) Return to previous menu
Enter selection (1-3,CR):
```

Figure F-16. External Pressure Parameters menu

2. To return to the Parameters and Configuration menu, press Enter.

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Pressure (internal) parameters

Initial setup of the Internal Pressure parameters is done at the factory. It is not recommended that the user change any of the values in this menu without consulting iRobot Customer Service.

- From the Parameters and Configuration menu, select **14**: **Pressure (internal) parameters**, and press Enter (Figure F-17).

  The current value for each parameter is in brackets to the right of the parameter name.

```
------ IntPressure (current value in [])-------
     1) $INT_PRESSURE_SLOPE [0.00976600003] Internal Pressure, slope (psig/AD$)
     2) $INT_PRESSURE_YINT [0] Internal Pressure, y-intercept (psig)
    CR) Return to previous menu
Enter selection (1-2,CR):
```

  Figure F-17. Internal Pressure Parameters menu

3. To return to the Parameters and Configuration menu, press Enter.

Compass parameters

Compass calibration is done at the factory. It is not recommended that the user change any of the values in this menu without consulting iRobot Customer Service.

1. From the Parameters and Configuration menu, select **15**: **Compass parameters** and press Enter (Figure F-18).

   The current value for each parameter is in brackets to the right of the parameter name.

```
------ Compass (current value in [])-------
          1) $TCM_PITCH_OFFSET [0] Pitch sensor offset (deg)
          2) $TCM_ROLL_OFFSET [0] Roll sensor offset (deg)
          3) $COMPASS_USE [0] Flags to indicate trust in compass returns
         CR) Return to previous menu
 Enter selection (1-3,CR):
```

   Figure F-18. Compass Parameters menu

2. To return to the Parameters and Configuration menu press, Enter.

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Altimetry parameters

1. From the Parameters and Configuration menu, select **16**: **Altimetry parameters,** and press Enter (Figure F-19).

   The current value for each parameter is in brackets to the right of the parameter name.

   For a description for each parameter and the acceptable range of values, see Chapter 5, “Piloting Parameters” on page 47.

```
------ Altimeter (current value in [])-------
         1) $ALTIM_BOTTOM_PING_RANGE [0] Range from (presumed) apogee
          depth to initiate bottom pings (m)
         2) $ALTIM_TOP_PING_RANGE [0] Depth to initiate top pings (m)
         3) $ALTIM_BOTTOM_TURN_MARGIN [0] Distance from obstacle to
          initiate bottom turn (m)
         4) $ALTIM_TOP_TURN_MARGIN [0] Distance from obstacle to initiate
            top turn (m)
         5) $ALTIM_TOP_MIN_OBSTACLE [1] Minimum obstacle depth to honor
            in initiating a subsurface finish (m)
         6) $ALTIM_PING_DEPTH [80] Depth at which to begin pinging for
          bottom (m)
         7) $ALTIM_PING_DELTA [5] Depth increment when pinging for bottom
          (m)
         8) $ALTIM_FREQUENCY [13] Frequency to use for pings (kHz)
         9) $ALTIM_PULSE [3] Pulse length to use for pings (ms)
         10) $ALTIM_SENSITIVITY [3] Altimeter sensitivity (0-5)
         11) $XPDR_VALID [2] Transponder interrogate validity length (x0.5
          ms) (0-6)
         12) $XPDR_INHIBIT [90] Transponder inhibit length (x100 of ms)
          (0-99)
          CR) Return to previous menu
Enter selection (1-12,CR):
```

Figure F-19. Altimetry Parameters menu

2. To change a parameter value, follow the procedures “Basic Mission and Seaglider Parameters menu” on page 282.

Sea-Bird CT calibration coefficients

The Sea-Bird CT calibration coefficients are loaded into Seaglider at the factory. The coefficients are CT sensor specific. It is not recommended that the user change any of the values in this menu without consulting iRobot Customer Service.

1. From the Parameters and Configuration menu, select **17**: **SBE CT coefficients,** and press Enter (Figure F-20).

   The current value for each parameter is in brackets to the right of the parameter name.

```
------ Parameters (current value in [])-------
     1) $SEABIRD_T_G [0.004302992] Seabird T g coefficient
     2) $SEABIRD_T_H [0.00062119117] Seabird T h coefficient
     3) $SEABIRD_T_I [2.2739867e-05] Seabird T i coefficient
     4) $SEABIRD_T_J [2.4046374e-06] Seabird T j coefficient
     5) $SEABIRD_C_G [-9.8404341] Seabird C g coefficient
     6) $SEABIRD_C_H [1.104722] Seabird C h coefficient
     7) $SEABIRD_C_I [-0.0022409149] Seabird C i coefficient
     8) $SEABIRD_C_J [0.0002592774] Seabird C j coefficient
    CR) Return to previous menu
Enter selection (1-8,CR):
```

Figure F-20. Sea-Bird CT Calibration Coefficients Menu

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NOTE:

- For units with GPCTD installed or no CT Sail, these parameters are set to 0.
- If changes are made to a SEABIRD coefficient, the change should also be made in the sg_calib_constants.m file for that Seaglider vehicle; see Appendix B, “Seaglider File Formats Manual” on page 201.

2. To return to the Parameters and Configuration menu, press Enter.

Power parameters

The Power parameters are loaded into Seaglider at the factory. It is not recommended that the user change any of the values in this menu without consulting iRobot Customer Service.

1. From the Parameters and Configuration menu, select **18**: **Power parameters**, and press Enter (Figure F-21).

   The current value for each parameter is in brackets to the right of the parameter name.

```
Enter selection (1-27,CR): 18
------ Power (current value in [])-------
          1) $AH0_24V [150] 24V-pack capacity (AmpHr)
          2) $AH0_10V [100] 10V-pack capacity (AmpHr)
          3) $MINV_24V [19] 24V-pack minimum voltage
          4) $MINV_10V [8] 10V-pack minimum voltage
          5) $FG_AHR_10V [0] 10V fuel gauge consumption
          6) $FG_AHR_24V [0] 24V fuel gauge consumption
          7) $PHONE_SUPPLY [2] Specifies battery for Iridium modem
           (1=10V, 2=24V)
         CR) Return to previous menu
Enter selection (1-7,CR): |
```

Figure F-21. Power Parameters menu

2. To return to the Parameters and Configuration menu, press Enter.

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Edit All Parameters

You can also edit the cmdfile to make changes to the Edit All Parameters. For how to edit the cmdfile, see “Command file” on page 172.

NOTE: Any edits you make to the SEABIRD coefficients either through the Edit All Parameters menu or the cmdfile, must also be made in the sg_calib_constants.m file. For information on this file, see Appendix B, “Seaglider File Formats Manual” on page 201.

1. From the Parameters and Configuration menu, select **19**: **Edit all parameters**, and press Enter.
   Figure F-22 shows 169 Seaglider parameters, with the current value assigned in brackets.
2. To edit a parameter value, follow the procedures “Basic Mission and Seaglider Parameters menu” on page 282.

```
------ All (current value in [])-------
  1) $ID [169] Glider ID (3 digits max)
  2) $MISSION [9] Current mission number
  3) $DIVE [21] Next dive number
  4) $D_SURF [3] Surface depth (m)
  5) $D_FLARE [5] Flare depth (m)
  6) $D_TGT [75] Target depth (m)
  7) $D_ABORT [1090] Abort depth (m)
  8) $D_NO_BLEED [200] Depth below which we will not bleed on dives (m)
  9) $D_BOOST [0] Depth above which only boost pump is run (m)
 10) $T_BOOST [0] Time to run the boost pump before turning off (0 do not turn off)
 11) $D_FINISH [0] Dive finish depth (m)
 12) $D_PITCH [0] Depth to achieve before surface maneuver pitch (m)
 13) $D_SAFE [0] Safety dive depth for emergency/escape maneuvers (m)
 14) $D_CALL [0] Depth to achieve before antenna is assumed to be out of water (m)
 15) $SURFACE_URGENCY [0] Number of dives to accumulate before trying extra surfacings
 16) $SURFACE_URGENCY_TRY [0] Dive number modulo for extra surfacing attempts
 17) $SURFACE_URGENCY_FORCE [0] Dive number modulo for forced extra surfacing attempts
 18) $T_DIVE [42] Target time per dive/climb cycle (min)
 19) $T_MISSION [55] Maximum mission time per dive/climb cycle (min)
 20) $T_ABORT [1440] Failsafe watchdog  mission time - change with extreme care (min)
 21) $T_TURN [225] Max time allowed for a turn maneuver (sec)
 22) $T_TURN_SAMPINT [5] Sample interval during a turn (int sec, >=4)
 23) $T_NO_W [120] Time with no vertical velocity (w) before taking next step (secs)
 24) $T_LOITER [0] Time to loiter at apogee before climbing (secs)
 25) $USE_BATHY [0] Use bathymetry map (0 - no, +/-nnn - file number)
 26) $USE_ICE [0] Use ice map for surfacing decisions (0 - no, +/-nnn - file number)
 27) $ICE_FREEZE_MARGIN [0.30000001] Margin (degC) in freezing point check for surfacing
 28) $D_OFFGRID [100] Max target depth if outside bathymap (m)
 29) $T_WATCHDOG [10] Watchdog timer (min)
 30) $RELAUNCH [1] Relaunch glider if crash to TCM8? (0=no/1=yes)
 31) $APOGEE_PITCH [-9] Intermediate pitch angle @ apogee (deg)
 32) $MAX_BUOY [200] Max buoyancy force allowed @ apogee (g)
 33) $COURSE_BIAS [0] Course bias to subtract from the computed (deg, +cw)
 34) $GLIDE_SLOPE [30] Max glide slope allowed (deg)
 35) $SPEED_FACTOR [1] Fudge factor for glider speed
 36) $RHO [1.023] Water density (grams/cc)
 37) $MASS [53373] Glider mass (g)
 38) $NAV_MODE [2] Navigation mode (0=direct/1=kalman/2=Set correct/3=Current relative)
 39) $FERRY_MAX [45] Ferry angle bound for set correction navigation (deg)
 40) $KALMAN_USE [0] Kalman filter (0=reset/1=enable/2=skip)
 41) $HD_A [0.003] Glider hydrodynamic lift (A)
 42) $HD_B [0.0142] Glider hydrodynamic drag (B)
 43) $HD_C [9.999997e-06] Glider hydrodynamic induced drag (C)
 44) $HEADING [-1] Heading (degrees true) to steer (-1 disable)
 45) $ESCAPE_HEADING [0] Escape heading (degrees magnetic) to steer in emergency
 46) $ESCAPE_HEADING_DELTA [10] Escape heading offset (degrees) in emergency
 47) $FIX_MISSING_TIMEOUT [0] Time (days) without fix before activating escape heading
 48) $TGT_DEFAULT_LAT [4743.75] Default target latitude
 49) $TGT_DEFAULT_LON [-12224.15] Default target longitude
 50) $TGT_AUTO_DEFAULT [0] Automatically update default target
 51) $SM_CC [375] VBD volume for surfacing (cc)
 52) $N_FILEKB [4] File segment size for upload (kBytes <=16, 0=no split, negative=no gzip)
 53) $FILEMGR [0] File management aggressiveness: 0=none, 1=only store compressed, 2=delete splits on failed phone call
 54) $CALL_NDIVES [1] # of dive/climb cycles before calling
 55) $COMM_SEQ [0] Comm sequence to use (0=default, 1=ctl only, 2=no loggers)
 56) $KERMIT [0] Use of kermit (0 - none, 1 - data only, 2 - data only, batch, 3 data and control, 4 data and control - data batch)
 57) $N_NOCOMM [1] # dives without communications before max surface
 58) $N_NOSURFACE [0] modulo for dives to finish under surface
 59) $UPLOAD_DIVES_MAX [-1] maximum # of dives to upload at each surfacing (-1 = all available)
 60) $CALL_TRIES [5] # of calls to try at each surfacing
```


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61) $CALL_WAIT [60] Delay between phone tries (sec)
62) $CAPUPLOAD [1] Upload capture file (0=no/1=yes)
63) $CAPMAXSIZE [100000] Maximum capture file size to upload (before compression)
64) $HEAPDBG [0] In depth heap debugging (0=off/1=on)
65) $T_GPS [5] GPS timeout (min)
66) $N_GPS [20] Max # valid GPS readings
67) $T_GPS_ALMANAC [0] Time to wait to reacquire the GPS almanac (mins)
68) $T_GPS_CHARGE [-14853.346] How long to trickle charge the GPS (secs)
69) $T_RSLEEP [3] Sleep interval during recovery (min)
70) $STROBE [0] Strobe control (0=never, 1=recovery, 2=surface)
71) $RAFOS_PEAK_OFFSET [1.5] Internal delay of RAFOS receiver (seconds)
72) $RAFOS_CORR_THRESH [60] threshold correlation value for hits used in navigation
73) $RAFOS_HIT_WINDOW [3600] window length (seconds) in which to search for hits to use in navigation
74) $PITCH_MIN [160 (-8.1 cm)] Pitch position limit, fwd (AD#)
75) $PITCH_MAX [3940 (3.7 cm)] Pitch position limit, aft (AD#)
76) $C_PITCH [2765] Pitch neutral point, (AD#)
77) $PITCH_DBAND [+/- 0.10] Pitch position deadband (cm)
78) $PITCH_CNV [0.003125763] Pitch position conversion factor (cm/AD#)
79) $P_OVSHOOT [0.039999999] Pitch mass overshoot after motor off (cm)
80) $PITCH_GAIN [29] Pitch angle to mass gain (deg/cm)
81) $PITCH_TIMEOUT [16] Pitch mass timeout (sec)
82) $PITCH_AD_RATE [175] Pitch motor AD counts per sec
83) $PITCH_MAXERRORS [1] Number of pitch errors allowed before entering recovery
84) $PITCH_ADJ_GAIN [0] Gain for auto-adjusting pitch (cm/deg)
85) $PITCH_ADJ_DBAND [0] Deadband for auto-adjusting pitch (deg)
86) $ROLL_MIN [177 (-57.6 deg)] Roll position limit, port (AD#)
87) $ROLL_MAX [387 (46.9 deg)] Roll position limit, stbd (AD#)
88) $ROLL_DEG [40] Roll position normal flight (deg)
89) $C_ROLL_DIVE [2215] Roll neutral point when diving and testing, (AD#)
90) $C_ROLL_CLIMB [2180] Roll neutral point when climbing, (AD#)
91) $HEAD_ERRBAND [+/- 10.00] Roll (scene)/Heading (auto) deadband,(deg)
92) $ROLL_CNV [0.028270001] Roll position conversion factor (deg/AD#)
93) $ROLL_TIMEOUT [15] Roll mass timeout, (roll and rollback, sec)
94) $R_PORT_OVSHOOT [50] Roll mass overshoot to port after motor off (AD)
95) $R_STBD_OVSHOOT [51] Roll mass overshoot to stbd after motor off (AD)
96) $ROLL_AD_RATE [350] Roll motor AD count per sec
97) $ROLL_MAXERRORS [1] Number of roll errors allowed before entering recovery
98) $ROLL_ADJ_GAIN [0] Gain for auto-adjusting roll center (deg battery roll / deg/sec turn rate
99) $ROLL_ADJ_DBAND [0] Deadband for auto-adjusting roll center (deg/sec)
100) $VBD_MIN [472 (638.5 cc)] VBD bladder position limit, minimum (AD$)
101) $VBD_MAX [3960 (-217.1 cc)] VBD bladder position limit, maximum (AD$)
102) $C_VBD [3075] VBD bladder neutral point, (AD$)
103) $VBD_DBAND [+/- 2.00] VBD bladder position deadband (cc)
104) $VBD_CNV [-0.245296] VBD bladder position conversion factor (cc/AD$)
105) $VBD_TIMEOUT [720] VBD timeout (sec)
106) $PITCH_VBD_SHIFT [0.0012300001] Pitch offset due to VBD (cm/cc)
107) $VBD_PUMP_AD_RATE_SURFACE [5] VBD pump AD counts per sec at surface
108) $VBD_PUMP_AD_RATE_APOGEE [4] VBD pump AD counts per sec at apogee
109) $VBD_BLEED_AD_RATE [8] VBD bleed AD counts per sec at surface
110) $UNCOM_BLEED [20] Uncommanded bleed change (AD) 0 - disabled
111) $VBD_MAXERRORS [1] Number of VBD errors allowed before entering recovery
112) $CFB_MAXERRORS [20] Number of CFB errors allowed before entering recovery
113) $AH0_24v [150] 24V-pack capacity (AmpHr)
114) $AH0_10v [100] 10V-pack capacity (AmpHr)
115) $MINV_24V [19] 24V-pack minimum voltage
116) $MINV_10v [8] 10v-pack minimum voltage
117) $FG_AHR_10V [0] 10V fuel gauge consumption
118) $FG_AHR_24V [0] 24V fuel gauge consumption
119) $PHONE_SUPPLY [2] Specifies battery for Iridium modem (1=10V, 2=24V)
120) $PRESSURE_YINT [-44.968971] Pressure, Y-intercept (psig)
121) $PRESSURE_SLOPE [0.00011645618] Pressure, slope (psig/AD$)
122) $AD7714Ch0Gain [128] AD7714 pressure chan gain (1=simulation/64=Druck 4020/128=Paine)
123) $TCM_PITCH_OFFSET [0] Pitch sensor offset (deg)
124) $TCM_ROLL_OFFSET [0] Roll sensor offset (deg)
125) $COMPASS_USE [0] Flags to indicate trust in compass returns
126) $ALTIM_BOTTOM_PING_RANGE [0] Range from (presumed) apogee depth to initiate bottom pings (m)
127) $ALTIM_TOP_PING_RANGE [0] Depth to initiate top pings (m)
128) $ALTIM_BOTTOM_TURN_MARGIN [12] Distance from obstacle to initiate bottom turn (m)
129) $ALTIM_TOP_TURN_MARGIN [0] Distance from obstacle to initiate top turn (m)
130) $ALTIM_TOP_MIN_OBSTACLE [1] Minimum obstacle depth to honor in initiating a subsurface finish (m)
131) $ALTIM_PING_DEPTH [80] Depth at which to begin pinging for bottom (m)
132) $ALTIM_PING_DELTA [5] Depth increment when pinging for bottom (m)
133) $ALTIM_FREQUENCY [13] Frequency to use for pings (kHz)
134) $ALTIM_PULSE [3] Pulse length to use for pings (ms)
135) $ALTIM_SENSITIVITY [3] Altimeter sensitivity (0-5)
136) $XPDR_VALID [2] Transponder interrogate validity lenth (x0.5 ms) (0-6)
137) $XPDR_INHIBIT [90] Transponder inhibit length (x100 of ms) (0-99)
138) $INT_PRESSURE_SLOPE [0.0097660001] Internal Pressure, slope (psig/AD$)
139) $INT_PRESSURE_YINT [2.3] Internal Pressure, y-intercept (psig)
140) $DEEPGLIDER [0] Am I a Deep Glider (0=No, 1 = Yes)
141) $DEEPGLIDERMB [0] Motherboard stuffed with high current sensors (0=No, 1 = Yes)
142) $MOTHERBOARD [4] Motherboard revision (NOPP=1,A.1=2,B.1=3,C=5)
143) $DEVICE1 [-1] Attached device 1 flags
144) $DEVICE2 [-1] Attached device 2 flags
145) $DEVICE3 [-1] Attached device 3 flags
146) $DEVICE4 [-1] Attached device 4 flags
147) $DEVICE5 [-1] Attached device 5 flags
148) $DEVICE6 [-1] Attached device 6 flags
149) $LOGGERS [1] Logger devices enable/disable control
150) $LOGGERDEVICE1 [85] Attached logger device 1 flags
151) $LOGGERDEVICE2 [-1] Attached logger device 2 flags
152) $LOGGERDEVICE3 [0] Attached logger device 3 flags
153) $LOGGERDEVICE4 [-1] Attached logger device 4 flags
154) $COMPASS_DEVICE [3] Compass device flags
155) $COMPASS2_DEVICE [-1] Compass 2 device flags
156) $PHONE_DEVICE [48] Phone device flags
157) $GPS_DEVICE [32] GPS flags
158) $RAFOS_DEVICE [-1] RAFOS device flags
159) $XPDR_DEVICE [24] XPDR device flags
160) $SIM_W [0] Simulated W (m/s) 0 - use pressure gauge to compute depth
161) $SIM_PITCH [0] Simulated dive pitch (e.g., -20 degrees) 0 - use TCM2 to report pitch
162) $SEABIRD_T_G [0.004302992] Seabird T g coefficient
163) $SEABIRD_T_H [0.00062119117] Seabird T h coefficient
164) $SEABIRD_T_I [2.2739867e-05] Seabird T i coefficient
165) $SEABIRD_T_J [2.4046374e-06] Seabird T j coefficient
166) $SEABIRD_C_G [-9.8404341] Seabird C g coefficient
167) $SEABIRD_C_H [1.104722] Seabird C h coefficient
168) $SEABIRD_C_I [-9.9999997e-05] Seabird C i coefficient
169) $SEABIRD_C_J [0.00025927747] Seabird C j coefficient
CR) Return to previous menu
Enter selection (1-169,CR):

Figure F-22. Edit All Parameters menu

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Validate parameters

1. Parameters and Configuration menu, select **20**: Validate Parameters and press Enter.

   The parameters are written to NVRAM. When the write is complete, you are automatically returned to the Parameters and Configuration menu.
2. To return to the Main Menu, press Enter.

Show parameter details

1. From the Parameters and Configuration menu, select **21**: **Show parameters,** and press Enter

   A table listing all Seaglider parameters, the group each parameter is in (basic, dive, surface, flight etc.) the nominal, min, and max values and a brief definition is displayed. No edits can be made in this menu.

   After the table is displayed, you are automatically returned to the Parameters and Configuration menu.
2. To return to the Main menu, press Enter.

Show changed parameters

1. From the Parameters and Configuration menu, select **22**: **Show changed parameters**, and press Enter.

   The names of the parameters whose values were changed under menu option 19 and the respective new parameter value are displayed.

   After the changed parameters are listed the user is automatically returned to the Parameters and Configuration menu.
2. To return to the Main menu, press Enter.

Clear changed parameters

1. From the Parameters and Configuration menu, select **23**: **Clear Changed Parameters**, and press Enter.

   This option returns any parameter values changed under option 19: Edit all parameters to the original value.

   After all parameter values are reverted back to original value the Parameters and Configuration menu is displayed.
2. To return to the Main menu, press Enter.

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Save parameters by name to a file

To access the Save Parameters By Name To A File option from the Parameters and Configuration menu:

1. From the Parameters and Configuration menu, select **24**: **Save parameters by name to a f**ile, and press Enter.

   The parameters and their respective current values are written to a file on the computer connected to Seaglider (Figure F-23). The filename format is SGxxxPRM.TXT, where xxx is the ID number of the Seaglider vehicle.

   ```
   13773.521,SUSR,N,Saving to SG506PRM.TXT...|
   ```

   Figure F-23. Save Parameters By Name To A File option

   After the file is written, the Parameters and Configuration menu is displayed.
2. To return to the Main menu, press Enter.

Dump parameters to screen

1. From the Parameters and Configuration menu, select **25**: **Dump parameters to screen**, and press Enter.

   All of the parameters and their respective current values are written to the screen.

   After the file is written, the Parameters and Configuration menu is displayed.
2. To return to the Main menu, press Enter.

Load parameters from a file

1. From the Parameters and Configuration menu, select **26**: **Load parameters from a file**, and press Enter.

   The SGxxxPRM.TXT file is loaded from the laptop onto Seaglider, where xxx is the ID number of the Seaglider vehicle.

   After the file is written, the Parameters and Configuration menu is displayed.
2. To return to the Main menu, press Enter.

Reset to defaults

1. From the Parameters and Configuration menu, select **27**: **Reset to defaults,** and press Enter.

   The default value for each parameter is loaded.

   After the file is written, the Parameters and Configuration menu is displayed.
2. To return to the Main menu, press Enter.

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Hardware menu (for tests and monitoring)

- To view the Hardware Menu used for tests and monitoring, select **2,** and press Enter (Figure F-24).

```
------ Hardware Menu ------
*Motors and VBD
     1 [pitch   ]  Pitch control
     2 [roll    ]  Roll control
     3 [vbd     ]  VBD control
*Fixed Devices
     4 [super   ]  Supervisor
     5 [pressure]  Pressure sensor
     6 [compass ]  Compass (tcm2)
     7 [gps     ]  GPS
     8 [modem   ]  Modem (xmodem mode)
     9 [intpress]  Internal pressure
    10 [altim   ]  Altimeter
    11 [sensors ]  Sensors
    12 [loggers ]  Loggers
*Other
    13 [batt    ]  Batteries and fuel gauges
    14 [lowlevel]  Low-level hardware (IO,A-D,CF)
    15 [misc    ]  Miscellaneous (travel, timeouts, date/time)
    16 [develop ]  Developer tests
    CR)  Return to previous
```

Figure F-24. Hardware menu

Pitch Control menu

- Select **1**: Pitch Control Menu, and press Enter (Figure F-25).

```
------ Pitch Control Menu ------
        1 [read    ]  Current position
        2 [ad      ]  Move to position (AD counts)
        3 [eu      ]  Move to position (cm, - for fwd)
        4 [edit    ]  Edit pitch parameters
        5 [cycle   ]  Run pitch duty cycles
        6 [cyclepr ]  Run pitch & roll duty cycles (CTL-Q to quit)
        7 [pitch   ]  Pitch test
       CR)  Return to previous
```

Figure F-25. Pitch Control menu

Current motor position

- To determine the current position of the pitch motor, select **1**: **Current position,** and press Enter.

  A reply similar to Figure F-25 is returned. Note that the pitch control position is given both in cm and A/D counts.

```
15313.427,HPITCH,N,   Pitch control position = -8.80 cm,
        (AD#= 365 )
```

Figure F-26. Current pitch control position information

The Pitch Control menu is displayed.

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Move to position (AD counts and cm)

There are two options to move the pitch motor:

- Change the A/D counts.
- Change the cm (centimeters) of movement.

Change the A/D counts

1. Select **2**: **Move to position (AD counts),** and press Enter (Figure F-27).

```
15582.616,HPITCH,N,   Pitch control position = -8.74 cm, (AD#= 385 )
Move to AD#:  [385]
```

Figure F-27. Current AD count for pitch motor

2. Type an A/D value, and press Enter.

   Figure F-28 shows an example with the A/D count changed to 395 and the resulting motor movement.

```
Move to AD#:  [385] 395
15599.680,HPITCH,N,Pitch commanded from -8.74 cm (385) to -
        8.71 cm (395)...
15600.932,HPITCH,N,-8.7 cm (ad: 385) MOTOR_DONE: ticks: 24
max 24v: 4.6mA avg 24v: 3.8mA minV 24v: 23.6V
15601.402,SMOTOR,N,GC TICKS/TIME: 27/28663
15601.492,HPITCH,N,done.
```

Figure F-28. Pitch motor movement by changing A/D counts

   At the end of the motor movement, the user is returned to the Pitch Control menu.

Change the cm (centimeters) of movement

1. Select **3**: M**ove to position (cm),** and press Enter.

   The response to this command is the same as the response to changing the A/D counts (Figure F-27).

2. Type a cm value, and press Enter.

   A positive value moves the pitch motor toward the aft end of Seaglider; a negative value moves the pitch motor toward the nose. Seaglider outputs the resulting movement like it did for the A/D count change.

   At the end of the motor movement, the user is returned to the Pitch Control menu.

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Edit pitch parameters

1. Select **4**: Edit pitch parameters, and press Enter (Figure F-12).

   The current value for each parameter is in brackets to the right of the parameter name.

   The explanation for each parameter and the acceptable range of values is located in Chapter 5, "Piloting Parameters" on page 47. The exact values of **$PITCH_MIN**, **$PITCH_MAX**, and **$C_PITCH** that should be used for the Seaglider being queried are located on the trim sheets in the notebook shipped with Seaglider.

   The instructions for editing a pitch parameter are located under "Pitch parameters" on page 288.

- To return to the Pitch Control menu, press Enter.

Run pitch duty cycles

1. Select **5**: Run Pitch Duty Cycles, and press Enter.

   As an example, Seaglider responds with:

```
Enter positions between -9.4 and 2.4 cm:
Start position of cycle: [-9.439804]
```

2. As an example, enter -8.5, and press Enter.

```
End position of cycle: [2.375580]
```

3. As an example, enter 1.5, and press Enter.

```
# of secs to rest at end of each cycle: [1]
```

4. As an example, use the default so press Enter.

```
# of cycles to execute (<32768): [10]
```

5. As an example, enter **1,** and press Enter.

   Seaglider then cycles the pitch motor and outputs the movement to the screen as the exercise is happening (Figure F-29).

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```
Cycling between -8.50 and 1.50 cm, hit any key to abort!
15875.935,HPITCH,N,Pitch commanded from -8.74 cm (385) to -8.50 cm (460)...
15877.053,HPITCH,N,-8.5 cm (ad: 449) MOTOR_DONE: ticks: 8 max 24v: 3.8mA avg 24v: 3.1mA minV 24v: 23.5V
15877.551,SMOTOR,N,GC TICKS/TIME: 26/28391
15877.641,HPITCH,N,done.
15877.783,HPITCH,N,Pitch completed from -8.74 cm (385) to -8.54 cm (449) took 0.4 sec 284mA (302mA peak) 23.1Vmin 170 AD/sec 15 ticks
15878.176,HPITCH,N,TRACK: b: 446/0 a: 448/0 d: -1 o: 1
15878.403,HPITCH,N,Pitch commanded from -8.54 cm (449) to 1.50 cm (3659)...
15879.585,HPITCH,N,-8.3 cm (ad: 527)
15880.335,HPITCH,N,-7.9 cm (ad: 668)
15881.110,HPITCH,N,-7.4 cm (ad: 815)
15881.860,HPITCH,N,-7.0 cm (ad: 953)
15882.635,HPITCH,N,-6.5 cm (ad: 1094)
15883.410,HPITCH,N,-6.1 cm (ad: 1234)
15884.160,HPITCH,N,-5.7 cm (ad: 1371)
15884.935,HPITCH,N,-5.2 cm (ad: 1513)
15885.710,HPITCH,N,-4.8 cm (ad: 1657)
15886.460,HPITCH,N,-4.3 cm (ad: 1796)
15887.210,HPITCH,N,-3.9 cm (ad: 1938)
15887.985,HPITCH,N,-3.5 cm (ad: 2075)
15888.760,HPITCH,N,-3.0 cm (ad: 2215)
15889.510,HPITCH,N,-2.6 cm (ad: 2352)
15890.285,HPITCH,N,-2.2 cm (ad: 2491)
15891.035,HPITCH,N,-1.7 cm (ad: 2626)
15891.785,HPITCH,N,-1.3 cm (ad: 2765)
15892.560,HPITCH,N,-0.9 cm (ad: 2895)
15893.310,HPITCH,N,-0.5 cm (ad: 3029)
15894.060,HPITCH,N,-0.1 cm (ad: 3159)
15894.835,HPITCH,N,0.3 cm (ad: 3288)
15895.585,HPITCH,N,0.8 cm (ad: 3422) Pitch motor timeout!
15896.235,HPITCH,N,
15896.385,HPITCH,N,1.1 cm (ad: 3521) MOTOR_DONE: ticks: 17 max 24v: 3.8mA avg 24v: 3.8mA minV 24v: 23.5V
15896.880,SMOTOR,N,GC TICKS/TIME: 700/702177
15896.972,HPITCH,N,done.
15897.111,HPITCH,C,Pitch completed from -8.54 cm (449) to 1.07 cm (3521) took 17.0 sec 273mA (304mA peak) 23.1Vmin 180 AD/sec 680 ticks; 1 errors
15897.541,HPITCH,N,TRACK: b: 3511/0 a: 3511/0 d: 135 o: 10
15898.284,HPITCH,N,Pitch commanded from 1.06 cm (3520) to -8.50 cm (460)...
15899.494,HPITCH,N,0.7 cm (ad: 3191)
15900.244,HPITCH,N,-0.1 cm (ad: 3161)
15900.994,HPITCH,N,-0.8 cm (ad: 2929)
15901.744,HPITCH,N,-1.5 cm (ad: 2687)
15902.519,HPITCH,N,-2.3 cm (ad: 2449)
15903.269,HPITCH,N,-3.0 cm (ad: 2210)
15904.019,HPITCH,N,-3.8 cm (ad: 1962)
15904.794,HPITCH,N,-4.6 cm (ad: 1722)
15905.544,HPITCH,N,-5.3 cm (ad: 1475)
15906.319,HPITCH,N,-6.1 cm (ad: 1236)
15907.094,HPITCH,N,-6.8 cm (ad: 991)
15907.844,HPITCH,N,-7.6 cm (ad: 751)
15908.594,HPITCH,N,-8.3 cm (ad: 511) MOTOR_DONE: ticks: 2 max 24v: 3.8mA avg 24v: 3.8mA minV 24v: 23.5V
15909.137,SMOTOR,N,GC TICKS/TIME: 394/396216
15909.229,HPITCH,N,done.
15909.369,HPITCH,N,Pitch completed from 1.07 cm (3521) to -8.50 cm (462) took 9.7 sec 79mA (321mA peak) 23.4Vmin 314 AD/sec 389 ticks
15909.765,HPITCH,N,TRACK: b: 473/0 a: 469/0 d: 3 o: -7
Cycle 1 completed...
```

Figure F-29. Pitch Duty Cycling

6. To stop the test at any time, press any key on the keyboard.

   At the end of the motor movement, the user is returned to the Pitch Control menu.

Run pitch and roll duty cycles

1. To run pitch and roll duty cycles at the same time, select **6**: Run Pitch and Roll Duty Cycles and press Enter.

   Seaglider responds with the limits within which pitch and roll can be moved and the format for the desired duty cycles.

   ```
   Pitch limits: -9.4 and 2.4 cm for pitch.
   Roll limits: -59.6 and 44.8 deg for roll.
   Enter moves as p,cm r,deg or s,milliseconds, one per line
   Ctrl-C aborts, blank line terminates entry
   ```

   The following example shows user input for a pitch and roll duty cycle.

   ```
   0: p,-8
   1: r,-3
   2: p,-6
   3: s,5
   4:
   ```

2. The input is complete, so press Enter.

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Seaglider responds with what it thinks it heard:

```
p,-8.000000
r,-35.000000
p,-6.000000
s,5.000000
```

and asks for the number of cycles.

```
# of cycles to execute: [10] 1
```

Seaglider cycles the pitch and roll motors and outputs the movement to the screen as the exercise is happening.

3. To stop the test at any time, press any key on the keyboard.

   At the end of the motor movement, the user is returned to the Pitch Control Menu.

Pitch test

1. To run the pitch motor from software stop to stop without user input, select **7**: **Pitch Test**, and press Enter.

   Seaglider then outputs the pitch motor movement on the screen.

   At the conclusion of the test, the user is returned to the Pitch Control menu.
2. To return to the Hardware Menu, one level up, press Enter.

Roll Control menu

The method for accessing the roll control options and performing tests is the same as it is for Pitch Control ("Pitch parameters").

1. Select **2**: **Roll control**, and press Enter (Figure F-30).

```
------ Roll control menu ------
     1 [read     ]  Current position
     2 [ad       ]  Move to position (AD counts)
     3 [eu       ]  Move to position (deg, + for stbd)
     4 [edit     ]  Edit roll parameters
     5 [cycle    ]  Run roll duty cycles
     6 [cycle pr]  Run pitch & roll duty cycles (CTL-Q to quit)
     7 [rolls    ]  Roll test
    CR)  Return to previous
```

Figure F-30. Roll Control menu

For instructions on making edits to the roll parameters, see "Roll parameters".

For a description for each parameter and the acceptable range of values, see Chapter 5, "Piloting Parameters" on page 47.

For the exact values of **$ROLL_MIN**, **$ROLL_MAX**, and **$C_ROLL**, see the trim sheets in the notebook shipped with the Seaglider vehicle.

NOTE: When making roll movements in degrees, negative degree values roll the vehicle to port, and positive degree values roll the vehicle to starboard.

2. To return to the Hardware menu, press Enter.

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VBD menu

The method for accessing options 1-4 is the same as it is for Pitch Control ("Pitch Control menu"). Options 5-12 are used for Seaglider development.

- Select **3**: **VBD control**, and press Enter (Figure F-31).

```
------ VBD menu ------
     1 [read     ]  Current position
     2 [ad       ]  Move to position (AD counts)
     3 [eu       ]  Move to position (cc)
     4 [param    ]  Edit vbd parameters
     5 [timing   ]  Characterize valve
     6 [noise    ]  Valve noise test
     7 [open     ]  Open valve
     8 [close    ]  Close valve
     9 [cycle    ]  Cycle valve
    10 [pump     ]  Pump & bleed cycles (pressure chamber or AD)
    11 [soak     ]  Pump and hold at pressure (pressure chamber or AD)
    12 [special  ]  Special test #1 (motor current, amb pressure & pot)
    CR)  Return to previous
```

Figure F-31. VBD Control menu

The method for accessing options 1-4 is the same as it is for Pitch Control ("Pitch Control menu").

For instructions on making edits to the VBD parameters, see Chapter F, "VBD parameters" .

For a description and acceptable range of values for each parameter, see Chapter 5, "Piloting Parameters" on page 47.

For the exact values of **$VBD_MIN**, **$VBD_MAX**, and **$C_VBD**, see the trim sheets in the notebook shipped with the Seaglider vehicle.

NOTE: When making VBD moves in AD counts, increasing the count moves oil into the internal reservoir. When making VBD moves in cc, negative values mean oil is moving into the internal reservoir.

Characterize valve

1. To characterize the valve, select **5**: **Characterize valve**, and press Enter.

   Seaglider responds with the following information:

   ```
   Delay in seconds on bleeds before checking progress: [2] |
   ```

2. If a 2-second delay (the default) is acceptable, press Enter; if not, type a new value, and press Enter.

   ```
   VBD change assumed after how many counts? [2] |
   ```

3. If 2 counts (the default) is acceptable, press Enter; if not, type a new value, and press Enter.

   ```
   47 Valve opened at 0 ms.
   .45 .44 .44 .43 .42 .42 .43 .0 Valve closed at 7 ms.|
   ```


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4. Pump back to starting state? [Y] Press Enter to continue test. To stop the test, type **N**, and press Enter.

   Seaglider echoes the valve activity to the screen (Figure F-32).

```
19727.304,HVBD,N,Pump commanded from -122.65 cc (3656) to 10.55 cc (3113)...
19728.636,HVBD,N,-121.9 cc (ad: 3653 [3692, 3611])
19729.461,HVBD,N,-119.7 cc (ad: 3644 [3684, 3603])
19730.286,HVBD,N,-117.7 cc (ad: 3636 [3676, 3595])
20442.731,HVBD,N,-163.1 cc (ad: 3821 [3850, 3791])
20443.581,HVBD,N,-161.4 cc (ad: 3814 [3842, 3783])
20444.406,HVBD,N,-159.2 cc (ad: 3805 [3833, 3775])
20445.206,HVBD,N,-157.7 cc (ad: 3799 [3829, 3769]) MOTOR_DONE: ticks: 20 max 24v: 6.1mA avg 24v: 3.8mA minv 24v: 23.5V
20445.830,SMOTOR,N,GC TICKS/TIME: 1725/1730380
20445.925,HVBD,N,done.
20446.086,HVBD,N,Pump completed from -230.09 cc (4094) to -157.48 cc (3798 [3829, 3768]) took 37.5 sec 345mA (262mA peak) 22.9vmin 7 AD/sec 1501 ticks; 1 retries
20446.560,HVBD,N,TRACK: b: 3830/3770 a: 3831/3770 d: -31 o: -33
```

Figure F-32. VBD valve characterization

At the conclusion of the valve characterization, Seaglider returns to the VBD menu.

Valve noise test

1. To check the VBD valve noise, select **6**: **Valve noise test**, and press Enter.

   Seaglider responds with the following information:

   ```
   Enter time in seconds to have the valve tested: [1] |
   ```

2. Press Enter if default answer, 1 second, is okay; if not, enter another value and press Enter.

   ```
   Open: Raise OPN before CLS? [Y] |
   ```

3. Press Enter if default answer, Yes, is okay; if not enter **N** and press Enter.

   ```
   Close: Drop OPN before CLS? [Y] |
   ```

4. Press Enter if default answer, Yes, is okay; if not enter **N** and press Enter.

   ```
   Offset time (in ms) between valve signals: [0] |
   ```

5. Press Enter if default answer, 0, is okay; if not, enter another value and press Enter.

   ```
   Bleed 4 counts on 1 second open and 21 counts on close.
   Pump back to starting state? [Y] |
   ```

6. Press Enter if default answer, Yes, is okay; if not, enter **N** and press Enter.

   During the test, Seaglider echoes the output to the computer (Figure F-33).

```
19952.303,HVBD,N,Pump commanded from 4.17 cc (3139) to 11.04 cc (3111)...
19953.649,HVBD,N,4.9 cc (ad: 3136 [3181, 3090])
19954.449,HVBD,N,6.6 cc (ad: 3129 [3173, 3083])
19955.224,HVBD,N,8.6 cc (ad: 3121 [3165, 3075])
19956.049,HVBD,N,10.5 cc (ad: 3113 [3157, 3068]) MOTOR_DONE: ticks: 3 max 24v: 4.6mA avg 24v: 3.8mA minv 24v: 23.4V
19956.614,SMOTOR,N,GC TICKS/TIME: 127/129063
19956.706,HVBD,N,done.
19956.855,HVBD,N,Pump completed from 3.92 cc (3140) to 11.28 cc (3110 [3154, 3066]) took 3.0 sec 51mA (290mA peak) 23.4vmin 9 AD/sec 121 ticks
19957.274,HVBD,N,TRACK: b: 3156/3067 a: 3156/3067 d: -45 o: -46
```

Figure F-33. Valve noise test

At the conclusion of the test, Seaglider returns to the VBD menu.

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Open valve

- To open the VBD valve, select **7**: **Open valve**, and press Enter
  Seaglider returns to the VBD menu.

Close valve

- To close VBD valve, select **8**: **Close valve**, and press Enter
  Seaglider returns to the VBD menu.

Cycle valve

1. To cycle the VBD valve, select **9**: **Cycle valve** and press Enter
   Seaglider returns:

   ```
   Enter time in ms to have the valve OPEN: [1000] |
   ```

2. If 1000ms is okay press Enter; if not, type a new value and press Enter.

   ```
   Number of cycles between reports: [20] 1|
   ```

3. If 1 is okay press Enter; if not, type a new value and press Enter.
   Seaglider then cycles the VBD valve echoing the activity back to the laptop (Figure F-34).

   ```
   20147.873,HVBD,N,Hit any key to abort...
   20149.171,HVBD,N,    VBD lin pot AD counts: 3178 3090
   20149.315,HVBD,N,    VBD bladder position = 5.40 cc, (AD#= 3134 )
   20150.611,HVBD,N,    VBD lin pot AD counts: 3202 3114
   20150.756,HVBD,N,    VBD bladder position = -0.49 cc, (AD#= 3158 )
   .
   .
   .
   20209.852,HVBD,N,    VBD lin pot AD counts: 4077 4088
   20210.007,HVBD,N,    VBD bladder position = -227.14 cc, (AD#= 4082)
   20211.305,HVBD,N,    VBD lin pot AD counts: 4089 4094
   20211.460,HVBD,N,    VBD bladder position = -229.35 cc, (AD#= 4091 )
   20212.759,HVBD,N,    VBD lin pot AD counts: 4094 4094
   20212.912,HVBD,N,    VBD bladder position = -230.09 cc, (AD#= 4094 )
   20214.212,HVBD,N,    VBD lin pot AD counts: 4094 4095
   20214.365,HVBD,N,    VBD bladder position = -230.09 cc, (AD#= 4094 )
   ```

   Figure F-34. VBD valve cycling

   At the conclusion of the test, Seaglider returns to the VBD menu.

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Pump and bleed cycles

This test is done in a pressure chamber. It is not recommended that this test be done outside of the iRobot factory.

1. To perform pump and bleed cycles, select **10**: **Pump and bleed cycles**.

   Seaglider returns:

   ```
   Do you want to specify pressure[Y] or VBD AD[N] limits? [Y] |
   ```

   In this example pressure, the default is the limit.

   ```
   20475.952,HVBD,N,
   Current pressure = 0.1
   Maximum pressure (psi): [1500.000000] 350|
   ```

2. Set the maximum pressure. For this example, pressure is set to 350.

   ```
   Time to rest @ max pressure (secs): [5] |
   ```

3. If 5 is okay press Enter; if not, type in a new value, and press Enter.

   ```
   Minimum pressure (psi): [0.000000]|
   ```

4. If 0 is okay press Enter; if not, type a new value, and press Enter.

   ```
   Time to rest @ min pressure (secs): [5] |
   ```

5. If 5 is okay press Enter; if not, type a new value, and press Enter.

   ```
   Sample report interval (secs): [1] |
   ```

6. If 1 is okay press Enter; if not, type a new value, and press Enter.

   ```
   Display readings? [Y] |
   ```

7. If the readings should display, press Enter; if not, type a new value and press Enter.

   ```
   Number of cycles to run: [10] 1|
   ```

8. Set the number of cycles to run, and press Enter. For this example, the number of cycles is 1.

   Seaglider starts the pump and bleed test and echoes the activity to the laptop screen (Figure F-35).

```
20503.396,HVBD,N,Hit any key to abort!
20503.491,HVBD,N, cycle    sec  vbd0  vbd1   avg     mA        P   psi
20504.415,HVBD,N,1  Pressure start: 0  end: 1910  VBD start: 3798  end: 3797
   Time: 0  cc/sec: 0.00  avg mA: 0.000
20504.621,HVBD,N,----- pumped to     3828    3765    3796 (0)----
20504.747,HVBD,N,Waiting for 5 sec...
20510.299,HVBD,N,-----bled to     3834    3773    3803 (0)-----
20510.422,HVBD,N,Waiting for 5 sec...
20515.558,HVBD,N,Cycle 1 completed ...
20515.661,SPOWER,N,powerOFF (3,VBD_pump_during_surface) without corresponding powerON!|
```

Figure F-35. VBD pump and bleed pressure test

9. To stop the test, press any key.

   At the conclusion of the test, Seaglider returns to the VBD menu.

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Pump and hold at pressure

This test is done in a pressure chamber. It is not recommended that this test be done outside of the iRobot factory.

1. To perform pump and hold at pressure cycles, select **11**: **Pump and bleed cycles**.

   Seaglider returns:

   ```
   Do you want to specify pressure[Y] or VBD AD[N] limits? [Y] |
   ```

   In this example pressure, the default is the limit.

   ```
   20642.025,HVBD,N,
   Current pressure = 0.2
   Maximum pressure (psi): [1500.000000] .1|
   ```

2. Set the maximum pressure. For this example, pressure is set to .1

   ```
   Sample report interval (secs): [1] |
   ```

3. If 1 is okay press Enter; if not, type a new value and press Enter.

   ```
   Display readings? [Y] |
   ```

4. If the readings should be displayed press Enter; if not, type new value and press Enter.

   Seaglider starts the pump and hold test and echoes the activity to the laptop screen (Figure F-36).

   ```
   20661.682,HVBD,N,Hit any key to abort!
   20661.777,HVBD,N, cycle sec  vbd0  vbd1 avg mA P   psi
   20662.137,HVBD,N,1  Pressure start: 0  end: 1483  VBD
             start: 3803  end: 3803
                      Time: 0  cc/sec: 0.00  avg mA: 0.000
   20662.343,HVBD,N,----- pumped to 3833 3772 3802 (0)----
   20662.483,SPOWER,N,powerOFF (3,VBD_pump_during_surface)
             without corresponding powerON!|
   ```

   Figure F-36. VBD pump and hold at pressure test

5. To stop the test at any time, press any key.

   At the conclusion of the test, Seaglider returns to the VBD menu.

Special test #1

This test is done in a pressure chamber. It is not recommended that this test be done outside of the iRobot factory.

1. To test the motor current, ambient pressure, and potentiometers, select **12**: **Special test #1**.

   Seaglider returns

   ```
   Sample interval (ms)? [1000] |
   ```

2. If the default value is okay, press Enter; if not, type in a new value, and press Enter.

   ```
   Max Pressure? [1500] 1|
   ```


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3. Set the minimum pressure. For this example, pressure is set to .1

```
Max Pressure? [1500] 500
```

4. Set the maximum pressure. For this example, pressure is set to .1.

```
Aborts when pressure > 500 psia, or any key hit !

Hit CR to start
```

5. To start the test, press Enter.

   Seaglider starts the test and echoes the activity to the laptop screen (Figure F-37).

```
time(sec)   pumpCur linPot1 linPot2    linAvg      AmbP      psia
    0.621   554.541    3834    3769      3801    377263       0.3
    2.121   489.346    3821    3755      3788    377214       0.3
```

Figure F-37. Special test #1

6. To stop the test at any time, press any key.

   At the conclusion of the test, Seaglider returns to the VBD menu.

Supervisor menu

The Supervisor menu options are used during the manufacture of Seaglider. It is not recommended that items in this menu be accessed outside of the iRobot factory.

1. Select **4**: **Supervisor**, and press Enter (Figure F-38).

```
      ------ Supervisor menu ------
    1 [sample  ]  Sample A-D channel
    2 [readad  ]  Read A-D register
    3 [monitor ]  Dump monitored A-D values
    4 [command ]  Send command
    5 [show    ]  Show gain, fuel, monitoring, heart and watchdog
      rates
    6 [setup   ]  Setup gain, fuel, monitoring, heart and watchdog
                  rates
    7 [readcfg ]  Read configuration registers
    8 [accum   ]  Read accumulators
    9 [clear   ]  Clear accumulators
   10 [minmax  ]  Clear min/max values
   11 [write   ]  Write register value
   12 [read    ]  Read register value
   13 [setrtc  ]  Set RTC clock (from TT8 clock)
   14 [testrtc ]  Set setting RTC clock (from TT8 clock)
   15 [rtctott8]  Set TT8 clock from RTC
   16 [readrtc ]  Read RTC clock
   17 [status  ]  Read status bytes
   18 [zerochk ]  Check current zero points
   19 [zeroset ]  Set current zero points
   CR)  Return to previous
Enter selection (1-19,CR):
```

Figure F-38. Supervisor menu

2. To return to the Hardware menu, press Enter.

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Pressure Sensor menu

In the Sealevel test, Seaglider takes a number (user determined) of pressure samples and calculates what the pressure y-intercept should be. You have the option of accepting or rejecting the new y-intercept value.

You can also edit the pressure parameters, although this is not recommended. iRobot Customer Service should be consulted before any pressure parameter values are changed through option 3.

1. Select **5**: **Pressure Sensor**, and press Enter (Figure F-39).

```
------ Pressure menu ------
     1 [selftest]  Basic self-test
     2 [sealevel]  Sealevel test
     3 [param   ]  Edit pressure parameters
    CR)  Return to previous
Enter selection (1-3,CR):
```

Figure F-39. Pressure Sensor menu

   The Basic self test outputs pressure measurements and an equivalent depth (m) value until you enter Control-Q.

2. To return to the Hardware menu, press Enter.

Compass/Attitude menu

The Compass/Attitude menu is used to set up the compass at the factory. It is not recommended that you change any of the values in this menu or attempt a recalibration without consulting iRobot Customer Service.

1. Select **6**: **Compass**, and press Enter (Figure F-40).

```
------ Compass/attitude Menu ------
     1 [selftest]  Basic self-test
     2 [active  ]  Toggle active compass
     3 [dispraw ]  Display raw bearing, pitch & roll
     4 [dispcal ]  Display calibrated bearing, pitch & roll
     5 [direct  ]  Direct comms with unit
     6 [capture ]  Capture compass serial output
     7 [command ]  Send command to SP3003
     8 [reset   ]  Reset SP3003
     9 [whirly  ]  Whirly calibration - display raw sensor outputs
    10 [whirlraw]  Whirly calibration - (SP3003 only) display
       transducer counts
    11 [config  ]  Configure TCM2
    12 [calib   ]  Calibrate compass
    13 [calibraw]  Calibrate compass (w/ SP3003 raw raw reader)
    14 [auto    ]  Autocalibrate compass manual (cal stand) mode
    15 [insitu  ]  Autocalibrate compass in-situ mode
    16 [coeff   ]  Read calibration coefficients
    17 [power   ]  Power cycle test
    18 [edit    ]  Edit compass parameters
    CR)  Return to previous
Enter selection (1-18,CR):
```

Figure F-40. Compass/Attitude menu

2. To return to the Hardware menu, press Enter.

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GPS menu

Use the GPS menu options to check the basic functionality of the GPS unit.

1. Select **7**: **GPS**, and press Enter (Figure F-41).

```
------ GPS Menu ------
     1 [selftest]  GPS self-test (acquire fix)
     2 [display ]  Display lat/long & sat info
     3 [direct  ]  Direct comm with unit
     4 [capture ]  Capture raw output
     5 [reset   ]  Reset to deployment mode
     6 [check   ]  Check almanac status
     7 [pps     ]  Check for presence of PPS signal
     8 [clock   ]  Use GPS to set TT8 RTC (uses PPS if available)
     9 [version ]  Report GPS version
    CR)  Return to previous
```

Figure F-41. GPS menu

2. To return to the Hardware menu, press Enter.

Modem menu

Use the Modem menu options to check the basic functionality of the Iridium phone.

1. Select **8**: **Modem**, and press Enter (Figure F-42).

```
------ Iridium phone menu ------
     1 [selftest]  Self-test (does not make phone call)
     2 [direct  ]  Direct comms
     3 [signal  ]  Monitor signal quality
     4 [locate  ]  Geolocate phone
     5 [remote  ]  Remote login and PicoDOS commands (xr and xs enabled
                   for transfer)
     6 [upload  ]  Exercise uploadData
     7 [uploadst]  Exercise uploadData self-test results only
     8 [current ]  Measure modem current
    CR)  Return to previous
Enter selection (1-8,CR):
```

Figure F-42. Iridium Phone menu

2. To return to the Hardware menu, press Enter.

Internal Pressure menu

The internal pressure parameters are set at the factory. It is not recommended that the user edit these values without consulting iRobot Customer Service.

1. Select **9**: **Internal Pressure**, and press Enter (Figure F-43).

   The self test outputs internal pressure and relative humidity measurements until you enter Control-Q.

```
------ Internal pressure menu ------
     1 [selftest]  Basic self-test
     2 [param   ]  Edit internal pressure parameters
    CR)  Return to previous
```

Figure F-43. Internal Pressure menu

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2. To return to the Hardware menu, press Enter.

Altimeter/XPDR menu

Use the Altimeter/XPDR menu to query the altimeter and the transponder functions.

The unit is configured at the factory. It is not recommended that the user edit the configuration values without consulting iRobot Customer Service.

1. Select **10**: **Altimeter/XPDR** menu, and press Enter (Figure F-44).

   Adjusting the altimeter parameters is done in the field as sensitivity varies with the environment the Seaglider vehicle is in.

```
------ Altimeter/XPDR Menu ------
     1 [ping    ]  Ping the altimeter
     2 [config  ]  Upload configuration to altimeter
     3 [count   ]  Query the transponder ping count
     4 [xpdrcfg ]  Update XPDR configuration from parameters
     5 [direct  ]  Direct comms with altimeter
     6 [param   ]  Edit altimetry parameters
    CR)  Return to previous
```

   Figure F-44. Altimeter/XPDR menu

2. To return to the Hardware menu, press Enter.

Sensors menu

1. Select **11**: Sensors menu and press Enter.

   A menu shows all of the installed science sensors. Figure F-45 shows that the SBE-CT sensors are the only ones installed.

```
------ Sensors menu ------
           1 [sbect   ]  SBE_CT
          CR)  Return to previous
```

   Figure F-45. Sensors menu

   When you select a sensor, you also specify how many samples the sensor should take. The data is then displayed on the screen. If there are zeros in the counts column, this means that there is no signal and the counter has timed out. The user needs to understand the reason for the lack of data and resolve the issue.

2. To return to the Hardware menu, press Enter.

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Loggers menu

1. Select **12**: **Loggers**, and press Enter.

   A menu shows all of the installed science sensors. Figure F-46 shows that the GPCTD is the only logger device installed.

```
------ Loggers menu ------
     1 [pc       ]  GPCTD
     2 [         ]  empty
    CR)  Return to previous
Enter selection (1-2,CR): 1
```

Figure F-46. Example menu

When you select a logger device, a list of all the functions available for that device appears (Figure F-47).

```
------ Logger device test menu ------
     1 [on       ]  Turn on
     2 [off      ]  Turn off
     3 [selftest]  Selftest
     4 [sample   ]  Report a sample
     5 [syncclk  ]  Synchronize device clock to TT8
     6 [clock    ]  Read device clock
     7 [file     ]  Get file from device
     8 [action   ]  Execute logger action
     9 [config   ]  Show configuration
    10 [edit     ]  Edit configuration
    11 [direct   ]  Direct comms
    CR)  Return to previous
```

Figure F-47. Loggers menu

Batteries and Fuel Gauges menu

1. Select **13**: **Batteries and Fuel Gauges** menu, and press Enter (Figure F-48).

```
      ------ Battery Functions ------
    1 [read     ]  View battery gauges
    2 [reset    ]  Reset battery gauges
    3 [backup   ]  Backup battery gauges
    4 [voltage  ]  Battery voltage
   CR)  Return to previous
```

Figure F-48. Batteries and Fuel Gauges menu

- When viewing the battery gauges (selection 1) the third column (since power-up) should contain zeros if the Seaglider is running on external power. However, if Seaglider is running on internal power, the third column is populated with non-zero values.
- Resetting the battery gauges (selection 2) is not recommended. This is a record of the usage and remaining life of the installed batteries.
- Backup battery gauges (selection 3) are not installed in iRobot gliders.
- The battery voltages option (selection 4) lists the present voltage on the 24V and 10V battery packs.

2. To return to the Hardware menu, press Enter.

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Low-Level Hardware menu

This menu is used during manufacture and if there is an apparent low level hardware failure. Do not make changes through this menu except at the direction of iRobot Customer Service.

1. Select **14**: **Low-level Hardware**, and press Enter (Figure F-49).

```
------ Lowlevel hardware functions ------
*I/O lines
     1 [io       ]  Set and read IO lines
     2 [watchdog]  Hang and test the watchdog
     3 [stroke   ]  Repetitively stroke the watchdog
*A/D converters
     4 [int      ]  Internal A/D
*Power control
     5 [measure ]  Measure device power
     6 [report   ]  Report active devices
*CompactFlash
     7 [cf       ]  CF card evaluation
     8 [size     ]  Report CF card size
*TPU
     9 [terminal]  Serial port terminal mode
    CR)  Return to previous
Enter selection (1-10,CR):
```

Figure F-49. Low-level Hardware menu

2. To return to the Hardware menu, press Enter.

Miscellaneous Hardware Functions menu

With the exception of the first (Prepare for Travel) and fourth (Read/set time-of-day) menu items, iRobot recommends that you do not access or change any of the other menu functions without consulting iRobot Customer Service.

1. Select **15**: Miscellaneous Hardware Functions menu, and press Enter (Figure F-50).

```
      ------ Miscellaneous hardware functions ------
   1 [travel  ]  Prepare for travel
   2 [iotime  ]  Change user IO timeout
   3 [timeout ]  Change watchdog time (mins)
   4 [date    ]  Read/set time-of-day
   5 [zerost  ]  Reset self-test counter to zero
   6 [fault   ]  Force a fault - WARNING, CRASHES to TOM8!!!!
   7 [dump    ]  Dump captured registers
   8 [walk    ]  Heap walk
  CR)  Return to previous
 Enter selection (1-5,CR):
```

Figure F-50. Miscellaneous Hardware Functions menu

- When you select **1**: **Prepare for travel,** Seaglider automatically puts itself into travel mode. It bleeds the external bladder, pitches fully forward, rolls to neutral and finishes the process with the statement “You are good to go!”. Each step of this process is echoed to the laptop screen.
- When you select **4**: **Read/set time-of-day**, the same procedure is the same as when Seaglider is first turned on (see “Interactive self test”, step 11 on page 136).

2. To return to the Hardware menu, press Enter.

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Developer Tests menu

The Developer Tests menu is for Seaglider developers only, and should not be used by customers.

1. Select **16: Developer Tests** menu, and press Enter (Figure F-51).

```
------ Developer functions ------
     1 [lpsleep ]  Test low-power sleep
     2 [report  ]  Report memory status
     3 [irq     ]  Test interrupt contention
     4 [toggle  ]  Toggle clearscreen
     5 [file    ]  Test file creation/manipulation
    CR)  Return to previous
Enter selection (1-5,CR):
```

Figure F-51. Developer Tests menu

2. To return to the Hardware Menu, press Enter.
3. To return to the Main Menu, press Enter again.

Test Operation Modes and Files menu

1. Select **3**: **Test Operation Modes and Files**, and press Enter (Figure F-52).
   - Selection 1:Test Bathymetry Files is the check that you will most often perform from this menu. It tests the successful loading of bathymetry files onto Seaglider. This is the same check that is done during a self test.
   - Selections 2 – 8 are used during Seaglider checkout at the factory and at the direction of iRobot Customer Service if a problem occurs with Seaglider.

```
------ Operational Functions Test Menu ------
     1 [bathy   ]  Test bathymetry files
     2 [recovery]  Test recovery
     3 [surface ]  Test surface maneuver
     4 [sample  ]  Test sampling and data file creation
     5 [angle   ]  Test surface measurements normal
     6 [upload  ]  Exercise uploadData regular operations
     7 [uploadst]  Exercise uploadData self-test results only
     8 [modes | ]  Test active/passive modes
    CR)  Return to previous
Enter selection (1-8,CR):
```

Figure F-52. Test Operation Modes and Files menu

2. To return to the Main Menu, press Enter.

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PicoDOS Commands menu

1. Select **4**: **PicoDOS Commands** (and exit), and press Enter (Appendix F-53, “PicoDOS Command menu”).

```
Enter extended and normal picoDOS commands at the prompt
 quit: returns to menu
 pdos: exits the program to pDOS
 tom8: exits the program to TOM8
??: gives help and hints
```

Figure F-53. PicoDOS Command menu

For more information on picoDOS commands, see Appendix C, “Extended PicoDOS® Reference Manual, v66.07”.

It is not recommended that the user exit down to the pdos or TT8 levels.

Pre Launch menu

- Select **5**: **Pre Launch menu**, and press Enter (Figure F-54).

```
------ Launch Menu ------
     1 [scene   ]  Set scenario mode
     2 [selftest]  Perform interactive self test
     3 [autotest]  Perform autonomous self test
     4 [uploadst]  Upload self-test results
     5 [reset   ]  Reset dive/run number
     6 [test    ]  Test Launch!
     7 [sea     ]  Sea Launch!
    CR)  Return to previous
```

Figure F-54. Pre Launch menu

Set Scenario Mode menu

Scenario mode is used with Seaglider in a test tank. This mode lets you program Seaglider to go through a series of pitch, roll, and/or VBD maneuvers. You determine the amount of motor or pump movement made during each step and the length of the scenario.

1. Select **1**: **Set Scenario Mode**, and press Enter.

   Follow the protocols shown with each step when designing the scenario.

   At the end of the scenario, Seaglider returns to the Scenario menu.
2. To return to the Pre Launch menu, press Enter.

Perform Interactive Self Test Mode menu

1. Select **2**: **Perform Interactive Self Test**, and press Enter.
2. Follow the interactive self test directions in Chapter 7, “Prelaunch Procedures” on page 133.

   At the end of the interactive self test, Seaglider returns to the Launch menu.

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Perform Autonomous Self Test menu

1. Select **3**: **Perform Autonomous Self Test**, and press Enter.
2. Follow the autonomous self test directions in Appendix E, “Autonomous Self Test” on page 269.

   At the end of the autonomous self test, Seaglider returns to the Launch menu.

Upload Self Test Results menu

1. To upload self test results to the laptop connected to Seaglider through the serial communications cable, select **4**: **Upload Self Test Results**, and press Enter.

   For an example of the output, see Figure 7-30 on page 152.

   At the end of the upload that Seaglider returns to the Launch menu.

Reset Dive/Run Number menu

1. Select **5**: **Reset Dive/Run Number**, and press Enter.

   Seaglider responds with the present dive number.
2. If the value of the dive number is correct, press Enter; if not, type a new dive number, and press Enter.

   Seaglider returns to the Launch menu.

Test Launch menu

1. To run simulated dives with Seaglider, select **6**: T**est Launch!** and press Enter.
2. Follow the simulated dives procedure in Chapter 7, “Prelaunch Procedures” on page 133.

   At the end of the test, Seaglider returns to the Launch menu.

Sea Launch menu

1. To run the last launch sequence before deploying a Seaglider, select **7**: **Sea Launch!** and press Enter.
2. Follow the sea launch procedure in Chapter 7, “Prelaunch Procedures” on page 133.

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Serial Port Data Transmission menu

Directly connect to the Seaglider through the communications cable, and launch a terminal program (TeraTerm preferred).

1. To return to the main menu, press Enter.
2. From the main menu, select **pdos** (4).
3. Enter the command to zip up all the files on the CF card into a .tar file
   `picoDOS>tar c temp.tar *`
4. Enter into extended PicoDOS:
   `picoDOS>> pdos`
5. When asked “Really exit to pdos? [N]” type `y` .
6. Change the baud rate to 38400:
   `PicoDOS>baud 38400`
7. Change TeraTerm’s baud rate to 38400 using the drop-down menu.
   `Setup > Serial Port…`
8. Start the xmodem transfer on the Seaglider:
   `PicoDOS>xs temp.tar`
9. Start the xmodem transfer on TermTerm using the drop-down menu:
   `File>Transfer>xmodem>Receive`
10. Move the .tar file from your laptop to the Seaglider directory (sgxxx) on the basestation with file transfer software (WinSCP...).
11. Navigate to the Seaglider directory on the basestation with a terminal emulator (Putty...).
12. Unzip the .tar file (where "tar file name = the name of the .tar file):
    `[xxxx@base sgxxx]$ tar xf Temp."tar file name"`
13. Enter the touch command:
    `[xxxx@base sgxxx]$ touch comm.log`
14. Enter the script to change the file extension [xxxx@base sgxxx]$ for file:
    `'ls *.A'; do newfile=${file:0:8}; newfile='echo $newfile | awk '{print tolower($0)}''.x00; cp $file $newfile; done`
15. Force the basestation data processing
    `[xxxx@base sgxxx]$ python /usr/local/basestation-2.05/Base.py -m . --force--verbose`

Your processed data will now be in the Seagliders directory on the basestation.

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APPENDIX G

Ballasting

Overview

Seaglider is ballasted externally to the pressure hull. The ballast areas are the nose of the forward fairing, the circumference of the electronics hull, and the rearmost battery hull. Ballast for the Seaglider is typically located in the nose and rearmost battery hull. The area around the electronics hull is rarely used. The ballast medium in the nose of the fairing is brass plates. The rearmost ballast can be in the form of lead strips (11.0g – 15.0g respectively) and/or syntactic foam strips.

Proper ballasting of the Seaglider allows the vehicle to optimally perform in the operational environment. Initially, based upon customer input, the Seaglider is delivered to the customer ballasted for the approximate bottom water density and maximum stratification in the deployment area. To complete the predelivery ballasting, iRobot requires the following parameters:

1. Estimated bottom water density in either kg/m_3 or g/cm_3
2. Estimated surface water density in either kg/m_3 or g/cm_3
3. Expected current in the deployment area (kts or m/s) or the desired thrust (cc)

Based on the customer provide information, iRobot calculates and affixes the appropriate weights to the outside of the pressure hull, and provides the customer with the calculated **$C_VBD**, **$C_PITCH**, **$C_ROLL_DIVE**, and **$C_ROLL_CLIMB** for the mission environment. The pilot fine-tunes these values at the beginning of the deployment.

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Reballasting in the field

If the glider needs to be reballasted for a different environment between deployments, contact iRobot for assistance. iRobot provides new weight estimates and the positions on the glider where the weights should be changed.

Equipment Required

- #2 Phillips screwdriver
- Flat blade screwdriver
- 4 oz ball peen hammer
- Isopropyl alcohol
- Lead ballast strips
- Syntactic foam strips
- Carpet tape
- Scotch Super 88 vinyl electrical tape (1.5" wide)
- Box knife
- Large zip ties or plastic banding
- Tef-Gel

Equipment Required (Continued)

- Brass screws and lock washers for nose weight plates
- 3/8" ratchet
- 36" 3/8" extension
- 12" 3/8 extension
- 3/16" hex bit
- 3/8" hex socket
- Nose weight installation tool
- Needle nose pliers

You add or remove the nose weight plates by removing the two brass socket head cap screws that secure the nose weights to the nose of the forward fairing. If you are adding weight plates, before installing the nose, apply a thin coating of Tef-Gel to the plate surfaces that will come in contact with one another.

Table G-1 lists the quantity of screws needed to attach the nose plates, as determined by the number of nose weight plates used.

Table G-1. Quantity of screws to attach nose plates

Qty	Qty of 1/4" Nose Plates	Qty of 1/8" Nose Plates	Screw Length (1/4" – 20")
2	1	2	3/4
2	2 to 3	4 to 6	1 1/2
2	4 to 5	8 to 10	2.0

Lead ballast on the exterior of the aft segment of the pressure hull is affixed using carpet tape and held in place with the straps around the battery hull. Use an EPDM rubber pad to isolate the lead ballast from the hull. The rubber pad also protects the pressure hull (pupa) from anodizing and allows for expansion and contraction of the hull (Figure G-2).

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Adjust lead ballast

1. Remove the forward fairing.
2. Take note of lead values and location on the pressure hull (pupa) (see the lead worksheet tab on Trim Sheet). When changing ballast by adding or subtracting lead, the changes must be made according to the diagram provided by iRobot.
3. Remove straps from pressure hull. If zip ties are used as the strapping material, cut them off over the rubber area so as not to damage anodizing on the pressure hull. If buckles and straps are used as the strapping material, release the buckle with a flat blade screwdriver.
4. If removing or moving lead strips, use a flat screwdriver to pry up one side of the lead from the tape and pull off.
5. Remove the old carpet tape, and clean the area with isopropyl alcohol and a lint free cloth, to remove any remaining glue or dirt from the tape.
6. Remove protective coating and apply new carpet tape to rubber pad.

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7. Install rubber pad to central lead position according to the supplied Ballast Pin Wheel diagram.

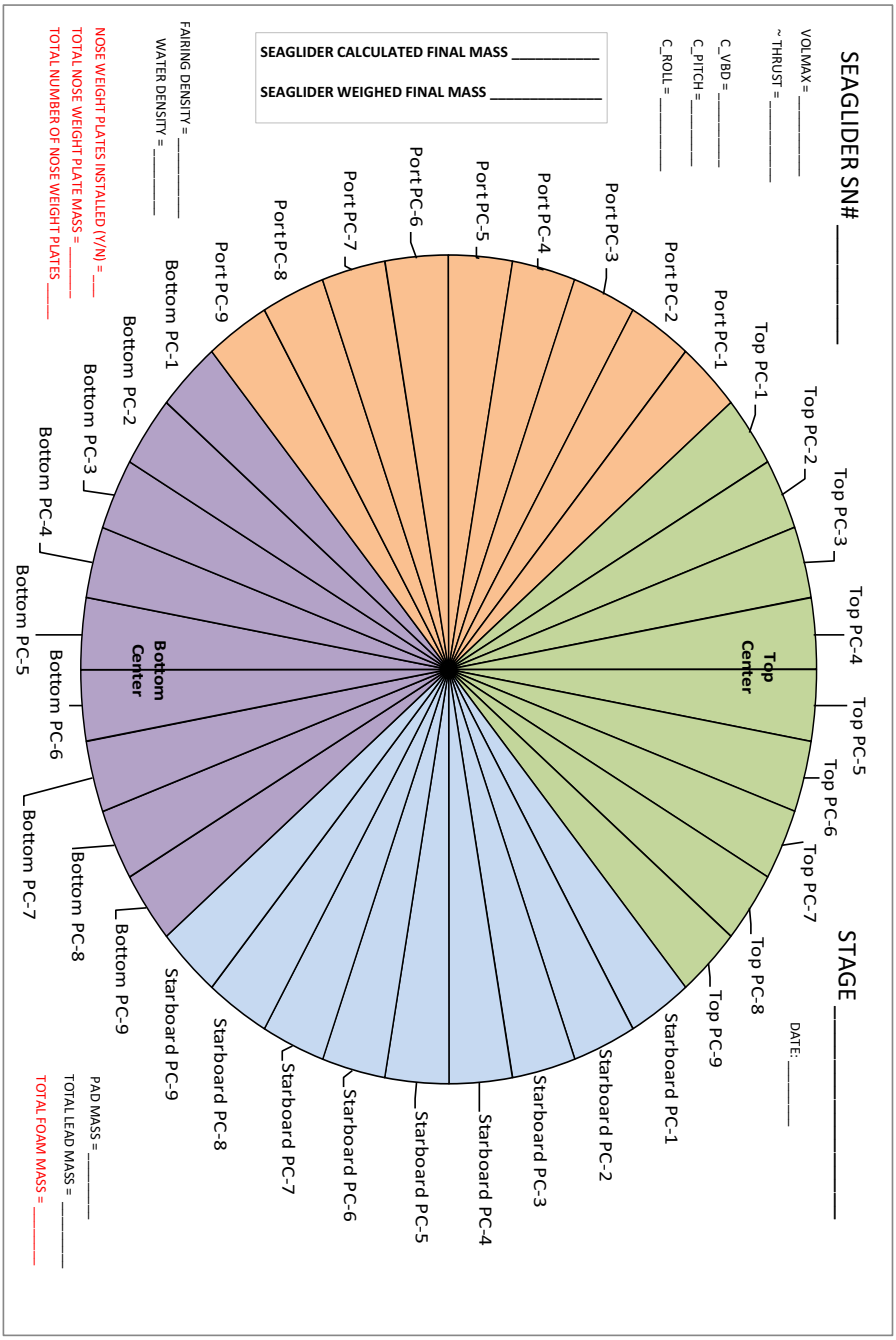


Figure G-1. Pinwheel diagram showing ballast locations

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8. Place new lead ballast on the pressure hull using the diagram supplied by iRobot. Figure G-1 is an example of the drawing that shows the positioning of the new lead.



Figure G-2. Lead ballast affixed to pressure hull

9. Using a ball peen hammer, lightly tap the lead until it conforms to the general shape of the battery hull.
10. Install two new zip ties or buckled straps.

    Make sure that the straps are pulling opposite one another and that the buckles are offset from one another. The further the buckle offset the better (Figure G-3).

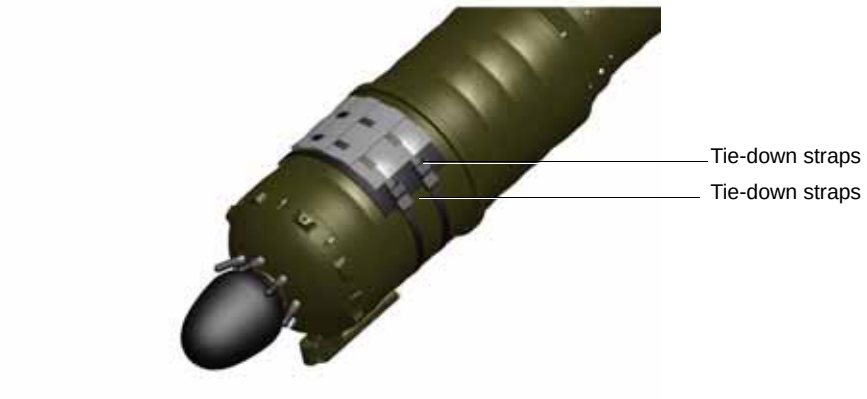


Figure G-3. Lead ballast secured with straps

11. Record lead values and location on the battery hull. See ballast pin-wheel (the first piece of lead trim is located in the bottom quadrant PC-1).
12. Reinstall forward fairing.

NOTE: If lead is moved between deployments to a different location on the pressure hull, the pilots have to trim roll during the first few dives.

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Apply or adjust syntactic foam ballast

1. Remove the forward fairing.
2. Take note of foam values and location on the pressure hull (pupa) (see the lead worksheet tab on Trim Sheet). When changing ballast by adding or subtracting foam, the changes must be made according to the diagram provided by iRobot.
3. Remove the installed wraps of vinyl tape making sure that none of the foam pieces are lost.
4. If the foam falls off, remove all the foam in order and then remove the strip of carpet tape.
5. Clean the pressure hull with isopropyl alcohol to remove any remaining glue or dirt from the tape. Dry with a lint free cloth.
6. Apply a new strip of carpet tape that is long enough to accommodate all the foam to the pressure hull (pupa) (Figure G-4).



Figure G-4. Applying syntactic foam ballast to pressure hull

7. Reapply the required amount of syntactic foam to the carpet tape.

   Apply Scotch Super 88 1.5" wide vinyl tape in three sections around pupa. One in the middle of the foam, one on each end of the foam covering half on the pupa and half on the foam to secure the foam in place. The tape is applied partially on the foam and partially on the pressure hull to create a sealed pocket for the foam to sit in (Figure G-5).



Figure G-5. Syntactic foam ballast affixed to pressure hull

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8. Record foam values and location on the battery hull. (See the ballast pinwheel; the first piece of trim is located in the bottom quadrant PC-1).
9. Reinstall forward fairing.

NOTE: If foam is moved, between deployments, to a different location on the pressure hull, the pilots have to trim roll during the first few dives.

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APPENDIX H

AD2CP Compass Calibration Procedure

If you receive your Seaglider with the ADCP sensor already installed at the factory, the compass calibration procedure has already been performed. If you are installing the ADCP on your own, you must procure the same equipment to calibrate the Seaglider internal compass.

Personnel Required

2 procedure operators

Equipment Required

Seaglider pressure hull
Wand to power on/off Seaglider
50-foot Seaglider communications cable
Laptop computer with Tera Term installed
Digital inclinometer
Inclinometer mount
Pressure hull compass calibration stand
PVC spacer for calibration stand

Equipment Required (Continued)

Calibration stand support pipe with heading marks, aligned to true north, permanently installed in an area with low magnetic interference (see Figure H-1)
S00708 Dry lubricant, spray
Rags or paper towels
Nortek AD2CP sensor (if sensor is to be installed)
Ogive aft fairing kit to hold AD2CP (if sensor is to be installed)

Preconditions

Assembled Seaglider pressure hull; successfully completed hardware test and verification
AD2CP sensor, if applicable

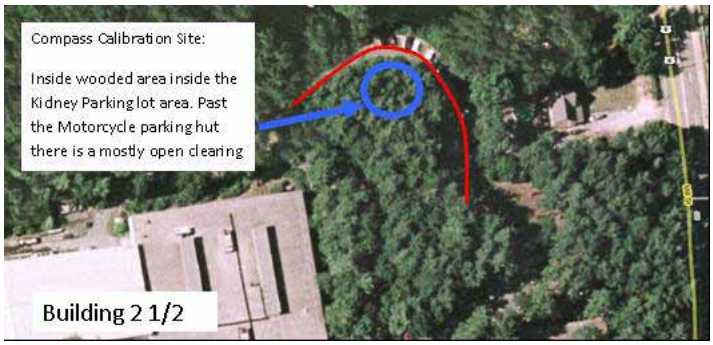

Compass Calibration Site:
Inside wooded area inside the Kidney Parking lot area. Past the Motorcycle parking hut there is a mostly open clearing
Building 2 1/2

Figure H-1. Polaris compass calibration site

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Pressure hull preparation

Prior to traveling out to the pedestal stand to perform the compass calibration, complete the following tasks:

1. The Seaglider system must be vacuum pulled prior to compass calibration.
2. The Seaglider system must be in travel mode during transport to and from compass calibration stand. (See section 6.6 for instructions on how to place Seaglider in travel mode).
3. Install the pressure hull inclinometer mount:
   a. Remove the 2 screws located ont eh bulkhead (Figure H-2).
   b. Install the longer hex screws into the bulkhead to fix the inclinometer mount in place. Screw locations are located at 45 degrees and -45 degrees from the center line.



Figure H-2. Inclinometer mount assembly

Create compass calibration stand

Prior to beginning the actual calibration test, you must install the pressure hull calibration mount onto the pedestal stand.

NOTE: To perform this task, two people are required to lift and affix the mount to the pedestal.

1. Clean the indicator disk surface.

   The indicator disk surface needs to be clean of any debris, such as dirt, ice, pine combs, pine needles, etc.
2. Clean the surface of the PVC spacer.
3. Lightly spray the surface of the indicator disk with S00708 lubricant.
4. Lightly spray both sides of the PVC spacer with S00708 lubricant.
5. Place the PVC spacer on top of the indicator disk and align it such that the PVC spacer does not overlap the inner diameter hole. The PVC spacer in combination with the lubricant serves as a way to reduce the friction and allow the stand to rotate easily.

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6. Place the pressure hull compass calibration stand on top of the indicator disk with the PVC spacer sandwiched between. When the stand is in place, rotate it two to three times in both directions to ensure that it is seated properly.

   NOTE: Several versions of the calibration stand exist, so the appearance of the stand may vary, but the assembly method is the similar.



Figure H-3. Calibration stand correctly assembled

Pressure hull installation into calibration mount

NOTE: To perform this task, two people are required to lift and set the pressure hull in place.

1. Position the cart, used to transport the pressure hull, in place close to the calibration mount.
2. On the calibration mount, open the compass calibration clamp.
3. Lift the pressure hull and place it into the clamp. The joiner ring on the pressure hull sits into the recess of the clamp.

   For the beginning of the calibration, the Seaglider system should be level with the forward section of the Seaglider, directed to a heading of 000, pitch set to the 0 degree level detent, and roll set with the inclinometer indicating 0 ±0.5 degrees.

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Compass calibration test

WARNING:
Connect transponder *before* powering up the Seaglider system.

CAUTION:
Before continuing, remove all magnetic materials and place them well away from the calibration mount (for example, belt, watch, cell phone, jewelry).

NOTE: If at any point in this procedure the sensor responds with the word ERROR, first try repeating the step, and then try executing steps 5-7; they describe the break sequence that should get the sensor back into a mode to accept commands.

1. Connect the communication cable from Seaglider system to a laptop.
2. Open a Tera Term session on the test laptop.
3. Wand the Seaglider pressure hull on, and enter the current date and time.
   ```
   Set current date and time
   <CR> for default [04/20/2009 05:25:12] 01/29/2010 10:30:00
   Are you running on external (bench) power? [N]
   ```
4. From the Seaglider Main menu, enter:
   `hw->loggers->cp->direct`
5. Type: `@@@@@@`
6. Wait a few seconds and type: `K1W%!Q` and press Enter.
   The sensor returns the response OK.
7. Type `MC` and press Enter.
   The sensor returns the response OK.
8. Type `SETUSER,HX=0,HY=0,HZ=0` and press Enter.
   The sensor returns the response OK.
9. Type `SAVE,USER` and press Enter.
   The sensor returns the response OK.
10. Type `COMPASSCONT,5,"CalFile_SG506_7_25_12.txt"` (include quotation marks), where SG506 is the glider number and 7_25_12 is some unique file identifier (this example uses the date). Press Enter.
    Sensor data streams to the terminal.
11. Move the glider as follows. Each sequence should be completed smoothly and slowly, with each full rotation taking at least 60 seconds to complete. All heading rotations can go in either direction to minimize the cable tangling around the stand.
    - Keeping the pressure hull level, rotate the heading around 360 degrees, starting at 000, and coming back to 000.
    - With the pressure hull still pointed at 000, remove the detent pin that sets the pitch angle, and pitch the nose of the pressure hull down to -30 degrees, then reinsert the detent pin. Rotate the heading around 360 degrees, starting at 000, and coming back to 000.

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- With the pressure hull still pointed at 000, remove the detent pin that sets the pitch angle, and pitch the nose of the pressure hull down to -60 degrees, then reinsert the detent pin. Rotate the heading around 360 degrees, starting at 000, and coming back to 000.
- With the pressure hull still pointed at 000, remove the detent pin that sets the pitch angle, and pitch the nose of the pressure hull up to 30 degrees, then reinsert the detent pin. Rotate the heading around 360 degrees, starting at 000, and coming back to 000.
- With the pressure hull still pointed at 000, remove the detent pin that sets the pitch angle, and pitch the nose of the pressure hull up to 60 degrees, then reinsert the detent pin. Rotate the heading around 360 degrees, starting at 000, and coming back to 000.
- With the pressure hull still pointed at 000, position the pressure hull to a level pitch and roll, remove the detent pin that sets the pitch angle, and slowly pitch the pressure hull around a full 360 degrees, ending with the pressure hull back at the level pitch position, then reinsert the detent pin.

NOTE: If the compass calibration stand blocks a full 360 degree pitch maneuver, just slowly pitch the pressure hull as far up and then as far down as it will go.

- Position the pressure hull to 090 degrees heading with a level pitch and roll, then loosen the clamp and slowly roll the pressure hull 360 degrees, concluding with a roll angle visually set back to 0 (do not place the inclinometer on the glider during the calibration process).

12. Repeat steps 5-7.
13. Power down the Seaglider.
14. Connect powered ethernet cable w/ crossover dongle to a computer.
15. Set that computer's IP address to 192.168.0.200 and subnet mask to 255.255.255.0 .
16. Open a browser and go to address 192.168.0.240 .
17. Click the link to the Nortek instrument.
18. Under Filesystem, click the Mount button and then the Submit button.
19. Click the Data Files link.
20. Right-click the link to the calibration file that you entered in step 10 and select Save Target As (in this example the filename was CalFile_SG506_7_25_12.txt).
21. Save the calibration file to the folder where you keep the hardiron.m Matlab script.
22. Open MATLAB and set the current directory to the folder where you keep the hardiron.m Matlab script.
23. At the MATLAB prompt, type: `hardiron('CalFile_SG506_7_25_12.txt')` (include single quotation marks around the filename).
24. Write down the resulting 2 lines, which should be something like:

    ```
    SETUSER,HX=19,HY=44,HZ=2
    SAVE,USER
    ```

25. Repeat steps 4-7.
26. Enter the 2 lines that came from the MATLAB scripts, and press Enter after each line.

    The sensor returns the response OK after each time you press Enter.
27. To validate that the sensor accepted the settings from step 24, type `GETUSER,HX` and press Enter.

    Verify that the value returned equals the value of HX that was set in step 24.

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28. Type `GETUSER,HX` and press Enter.

    Verify that the value returned equals the value of HY that was set in step 24.

29. Type `GETUSER,HZ` and press Enter.

    Verify that the value returned equals the value of HZ that was set in step 24.

Follow-on task

After the compass calibration has been completed and passed, you must place the Seaglider sytem into travel mode.

1. Go to the Main menu (Figure H-4).
2. At the Main menu, select **2**: **Hardware Tests & Monitoring**, and press Enter.

```
------ Hardware Menu ------
*Motors and VBD
     1 [pitch   ]  Pitch control
     2 [roll    ]  Roll control
     3 [vbd     ]  VBD control
     4 [pressure]  Pressure sensor
     5 [compass ]  Compass (tcm2)
     6 [gps     ]  GPS
     7 [modem   ]  Modem (xmodem mode)
     8 [intpress]  Internal pressure
     9 [altim   ]  Altimeter
*Sensors
    10 [ct      ]  C,T sensors
    11 [nullct  ]  NULL C,T sensors
    12 [o2      ]  O2 sensor
    13 [wetlabs ]  WETLabs VSF & fluorometer
    14 [par     ]  QSP 2150 PAR sensor
    15 [optode  ]  Optode
*Other
    16 [batt    ]  Batteries and fuel gauges
    17 [lowlevel]  Low-level hardware (IO,A-D,CF)
    18 [misc    ]  Miscellaneous (travel, timeouts, date/time)
    19 [develop ]  Developer tests
    CR)  Return to previous
Enter selection (1-19,CR): 18 ———— Step 8
```

Figure H-4. Travel mode menu – 1

3. Type **18** (**[misc] Miscellaneous (travel, timeouts, date/time)**), and press Enter.

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4. When **Miscellaneous Hardware Functions** appears, type **1** (**[Travel] Prepare for travel** (Figure H-5)).

   Seaglider then bleeds the oil from the external bladder into the internal resevoir.

```
------ Miscellaneous hardware functions ------
     1 [travel  ]  Prepare for travel
     2 [iotime  ]  Change user IO timeout
     3 [timeout ]  Change watchdog time (mins)
     4 [date    ]  Read/set time-of-day
     5 [zerost  ]  Reset self-test counter to zero
     6 [fault   ]  Force a fault - WARNING, CRASHES to TOM8!!!!
     7 [dump    ]  Dump captured registers
    CR)  Return to previous
Enter selection (1-7,CR): 1 ———————— Step 9
Bleeding down...
1314.122,HVBD,N,Bleed commanded from 405.96 cc (1755) to 15.21 cc (3
1315.321,HVBD,N,403.5 cc (ad: 1765 [1772, 1771]) ...................
1326.521,HVBD,N,336.1 cc (ad: 2040 [2027, 2065]) ...................
1337.796,HVBD,N,271.5 cc (ad: 2303 [2304, 2310]) .......
```

   Figure H-5. Travel mode menu – 2

5. When the “good to go!” message appears, wand Seaglider off.

   Ensure that Seaglider is off by repeatedly pressing Enter on the laptop keyboard. If there is no response, Seaglider is turned off.

6. Quit the Tera Term session.

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APPENDIX I

Pilot and Field Team Checklist

Prepare the necessary software on field laptop

Step	Responsibility	Action
1	Field Team	Terminal Program ☐
2		Text Editor ☐

Prepare the necessary software on pilot computer.

Step	Responsibility	Action
1	Pilot	Secure shell program (Putty software or equivalent recommended) ☐
2		Navigational plotting program (Goggle Earth or equivalent recommended) ☐
3		MatLab ☐
4		Text Editor ☐
5		SCP (Secure Copy Protocol), program (WinSCP or simialr software recommended) ☐

Obtain pilot and field team contact information.

Step	Responsibility	Action
1	Field Team	Phone Number:
2		E-mail address:
3		Sattellite phone (if applicable):

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Obtain pilot contact information.

Step	Responsibility	Action
1	Pilot	Phone Number:
2		E-mail address:

Obtain basestation information

Step	Responsibility	Action
1	Pilot and Field Team	Telnum:
2		Altnum:
3	Pilot	IP address:
4		Username:
5		Password:

Self-test schedule

Step	Responsibility	Action
1	Pilot and Field Team	Location:
2		Date:
3	Field Team	Time self-test will be ready for review.
4	Pilot	Time self-test need to be completed.

Deployment schedule

Step	Responsibility	Action
1	Pilot and Field Team	Location:
2		Date:
3		Mission planning details should be organized (see Chapter 6, “Predeployment Tasks” on page 107)
4	Pilot	targets, science, sg_calib_constants.m, and command files generated:
5	Field Team	Time Field Team plans to be at deployment site:
6		Deployment Vessel being used:

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Recovery schedule

Step	Responsibility	Action
1	Pilot and Field Team	Location:
2		Date:
3	Field Team	Time Field Team plans to be at recovery site:
4	Pilot	Time and location Pilots will plan to have the Seaglider on the surface and ready for recovery:
5	Field Team	Recovery vessel being used:

Self-test process

Step	Responsibility	Action
1	Pilot	Logs into basestation and prepares to analyze Self-Test data files. ☐
2	Field Team	Performs a Self-Test on the Seaglider at the designated time. ☐
3		Informs the Pilot when the Self-Test has completed. ☐
4	Pilot	Analyzes the Self-Test data and fills out the Self-Test log sheet as required. ☐
5		Informs the Field Team if all systems are good and the Self-Test passes. ☐
6		Saves the Self-Test log sheet onto the basestaton. ☐

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Deployment process

Step	Responsibility	Action	
1	Field Team	Ensures the antenna is fully tightened. (If antenna was uninstalled, ensures that O-ring is present before reinstalling.)	☐
2		Ensures all cables and connectors are secure	☐
3		Assembles Seglider's wings, rudder and antenna	☐
4	Pilot	Logs into the basestation via secure shell method.	☐
5	Pilot and Field Team	Goes through Self-Test process.	☐
6	Pilot	Approves a successful self-test, and then gives the Field Team approval to go into Sea-launch mode.	☐
7	Field Team	Puts Seaglider into Sea-launch mode, and waits to click Yes to the question: Is Seaglider ready for Sea-launch?. Throughout the Sea-launch setup, watches to assure bladder inflates fully, the Seaglider finishes one call, and the Seaglider picks up the Quit command.	☐
8	Pilot	Checks PRM file closely to ensure the parameters are set correctly. If changes are necessary and applicable to being picked up directly before the dive, makes changes in common file.	☐
9		Gives the OK for sea-launch.	☐
10	Field Team	Types Y (for yes) and presses Enter to go into Sea-launch. Continues watching to assure bladder inflates fully, Seaglider finishes one call, and the Quit command came through.	☐
11		Disconnects the comms cable and installs the dummmy plug in its place.	☐
12		Travels to designated deployment site.	☐
13		Removes sensor covers	☐
14		Requests permission to deploy the Seaglider with a tether attached.	☐
15	Pilot	Approves the deployment.	☐
16	Field Team	Launches the Seaglider with tether attached.	☐
17		Acoustically pings the Seaglider with a transducer and deckbox.	☐
18		Reports back to Pilot the buoyancy quality of the Seaglider by describing how the Seaglider is sitting in the sea surface.	☐
19	Pilot	Instructs the Field Team to release the tether if buoyancy is correct and all systems are good.	☐
20		Prepares the Seaglider to dive.	☐

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21	Field Team	Reports to the Pilot once the Seaglider has submerged and is diving.	☐
22		Remains onsite while the Pilot analyzes the dive data.	☐
23	Pilot	Ensures the Seaglider is operating correctly.	☐
24		Informs the Field Team that they are clear to leave the sea-launch site area.	☐

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Flight process

Step	Responsibility	Action	
1	Pilot	Transfers dive data from the basestation onto their piloting computer for each dive.	☐
2		Plots the dive data with MatLab software.	☐
3		Trims the Seaglider as needed by analyzing the MatLab plots and making the required parameter changes.	☐
4		Looks for any odd flight behavior.	☐
5		Makes sure the science data is present and each sensor is producing good quality data.	☐
6		Makes sure the altimeter can find the bottom and is correctly tuned.	☐
7		Fills out dive log sheet if needed.	☐
8		Plots the Seagliders current GPS coordinates with navigational plotting software during each surfacing to monitor its current location.	☐
9		Monitors the tide and ocean current information to assist with predicting waypoint targeting.	☐
10		Flies the Seaglider as required between designated waypoints.	☐

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Recovery process

Step	Responsibility	Action	
1	Pilot	Ensures the Seaglider is flying towards the recovery waypoint in advance.	☐
2	Field Team	Notifies Pilot once they leave port on recovery vessel and their estimated steam-time to be onsite.	☐
3	Pilot	Changes the necessary parameters to put the Seaglider into shallow dives.	☐
4	Pilot	Ensures the Seaglider arrives at the designated recovery location at the designated time.	☐
5		Puts the Seaglider into recovery mode and insures it will remain on the surface.	☐
6		Notifies Field Team once the Seaglider is on the surface and in recovery mode.	☐
7		Relays the last known GPS coordinates to the Field Team.	☐
8	Field Team	Arrives at designated recovery location at designated time and informs the Pilot they're onsite.	☐
9		Searches for the Seaglider on the sea surface.	☐
10		Recovers the Seaglider.	☐
11		Informs the Pilot the Seaglider has been successfully recovered	☐
12		Attaches the necessary sensor protective covers.	☐
13		Poweres the Seaglider off	☐
14		Makes sure the Seaglider is powered off	☐
15	Pilot	Completes the dive log sheet and saves it onto the basestation if needed. Cleans up the basestation by putting data from this deployment in one folder.	☐
16	Field Team	Steams back to port.	☐
17		Properly cleans the Seaglider and all sensors.	☐
18		Puts the Seaglider into travel mode and properly stows it away.	☐

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APPENDIX J

Sample Field Kit Checklist

Field kit checklist

Check complete	Field kit checklist task
	1KA Seaglider (Self Tested with known Transducer Frequency and other parameters)
	Seaglider Cal Sheets - MOST CURRENT VERSION
	Laptop computer (charged overnight) with power adapter
	Field phone with power adapter (field location determines phone type - cell, Iridium)
	Handheld GPS unit with extra batteries
	Benthos DS-7000 (charged overnight)
	Benthos transducer safety line/ Seaglider tag line/cradle safety line
	Marine radio (check batteries)
	Power inverter (w/ spare fuses) and 12V battery (charged) (Optional)
	Extension cord
	Plug strip
	Communication cable (50 feet)
	Communication cable (10 feet)
	(2x) Sensor rinse water bottles: one with dionized water, one with 50:1 water to bleach solution
	Gallon of distilled water
	(2x) Magnetic wand
	Notebook and pencils or pens
	Extra screws (rudder, fairing, wings)
	Phillips screwdriver
	(3x) Quick clamps
	Foul weather gear
	Life preservers

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Check complete	Field kit checklist task
	Binoculars
	Boots or closed-toe shoes
	Tide chart for date of launch/recovery
	Sensor plugs/covers
	Rinse hose
	Paper towels
	Tie down straps and bungee cords
	Sunscreen
	Drinking water
	Sunglasses
	Spare rudder, wings, or antenna (Optional)

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APPENDIX K

Standard Limited Warranty to Original Purchaser

SEAGLIDER™ ONE (1) YEAR WARRANTY TO ORIGINAL PURCHASER

1. **Warranty, Exclusive Remedies and Warranty Disclaimers.**

1.1 **Warranty**. iRobot warrants that devices sold hereunder shall be free from defects in materials and workmanship under normal use and service when correctly operated in accordance with the iRobot instructions and training for a period of one (1) year from date of acceptance ("Warranty"). iRobot reserves the right and sole discretion to modify this Warranty at any time with written notice. Customer's receipt of any device delivered hereunder shall be an unqualified acceptance of and a waiver by Customer of the Customer's right to make a claim with respect to such device unless Customer gives iRobot written notice of any claim within one (1) year after acceptance of such device.

1.2 **Exclusive Remedy.** The sole obligation of iRobot, and Customer's sole and exclusive remedy for a breach of the Warranty in Section 1.1, shall be that iRobot shall use commercially reasonable efforts to repair and correct, or, at iRobot's option, replace the device which shall have been promptly reported in writing as not operating in accordance with the Warranty and, upon inspection by iRobot shall be determined to not have met the Warranty, provided the device was not abused or operated other than in accordance with the iRobot instructions. If iRobot is unable to repair or correct the software in a reasonable amount of time in accordance with this Section 1, iRobot will refund to Customer the amount paid for such device, in which case Customer shall return the device to iRobot.

1.3 **Assignment.** iRobot hereby assigns to Customer all of the manufacturers' warranties relating to the equipment which iRobot is permitted by the equipment manufacturer(s) to assign to Customer. Such assignment is subject to all of the terms and conditions imposed by the equipment manufacturer(s) with respect thereto. iRobot will use commercially reasonable efforts to promptly apprise Customer of such warranties following Customer's purchase of the equipment.

1.4 **Disclaimers. EXCEPT FOR THE FOREGOING EXPRESS WARRANTY SPECIFIED ABOVE, IROBOT GRANTS NO WARRANTIES, EITHER EXPRESS OR IMPLIED. IROBOT EXPRESSLY DISCLAIMS THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, AND NONINFRINGEMENT FOR THE DEVICE(S), IN WHOLE AND IN PART. IROBOT DOES NOT ASSUME LIABILITY FOR LOSS, DAMAGE, OR OTHER RESULTS OF OPERATING THE DEVICE IN WATER, OR DUE TO LEAKAGE, IMPLOSION, OR EXPLOSION. THE WARRANTY WILL NOT APPLY TO THE DEVICE IF THERE IS A FAILURE OF THE DEVICE OR ANY PART**

IMPORTANT NOTICE:
WARNING - This Document contains Technical Data whose export is restricted by the Arms Export Control Act (TITLE 22, U.S.C., SEC 2751 ET SEQ.) or the Export Administration Act of 1979, as amended, (TITLE 50, U.S.C.. APP. 2401, ET SEQ). Violations of these export laws are subject to severe criminal penalities.

THEREOF WHICH IS ATTRIBUTABLE TO: (A) INAPPROPRIATE OR UNAUTHORIZED USE OF THE DEVICE; (B) ACCIDENT, NEGLECT, MISUSE OR ABUSE OF THE DEVICE; (C) EXPOSURE OF THE DEVICE TO POTENTIALLY HARMFUL ENVIRONMENTAL, POWER, AND OPERATING CONDITIONS; (D) CUSTOMER SPECIFIC MODIFICATIONS NOT PERFORMED BY IROBOT WITHOUT RECEIPT OF APPLICABLE TRAINING; OR SEA STATE. IROBOT DOES NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE DEVICE WILL MEET CUSTOMER'S REQUIREMENTS, THE OPERATION OF THE DEVICE WILL BE UNINTERRUPTED OR ERROR-FREE OR THAT ALL DEFECTS WILL BE CORRECTED.

2. **Limitations of Liability and Disclaimer of Damages.**

2.1 **Liability for Use or Loss at Sea. CUSTOMER SHALL BE SOLEY RESPONSIBLE FOR ANY LIABILITY RESULTING FROM THE USE OR LOSS OF THE DEVICE AT SEA INCLUDING, BUT NOT LIMITED TO, USE OR LOSS RESULTING RESULTING FROM THE APPLICATION OF THE REGULATIONS OR RESTRICTIONS OF THE MARINE POLLUTION ACT (MARPOL), THE ENVIRONMENTAL PROTECTION AGENCY, THE UNITED STATES COAST GUARD, ANY ACT THAT ENABLES THE EXISTENCE OF MARINE PROTECTED AREAS (BOTH U.S. AND OTHER), AND ANY OTHER STATE, REGIONAL, COUNTY, OR LOCAL REGULATIONS OR OF ANY THIRD PARTY STATE OR NATION.**

2.2 Disclaimer of Damages. NOTWITHSTANDING ANYTHING TO THE CONTRARY IN THIS AGREEMENT, IT IS EXPRESSLY AGREED THAT IROBOT AND ITS SUPPLIERS SHALL IN NO EVENT BE LIABLE FOR TORTIOUS CONDUCT (INCLUDING BUT NOT LIMITED TO NEGLIGENCE OR STRICT LIABILITY) OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES RELATING TO OR ARISING OUT OF THE AGREEMENT, EVEN IF IROBOT IS ADVISED OF THE

POSSIBILITY OF SUCH DAMAGES. SUCH EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, LOSS OF GOODWILL, INTERRUPTION OF BUSINESS, DEVICES NOT BEING AVAILABLE FOR USE, LOST OR CORRUPTED DATA, LOSS OF BUSINESS, LOSS OF PROFITS, LOSS OF USE OF THE DEVICE OR ANY ASSOCIATED EQUIPMENT, COST OF CAPITAL, COST OF SUBSTITUTE OR REPLACEMENT PRODUCT, FACILITIES OR SERVICES, DOWN-TIME, CHARGES FOR CUSTOMER'S TIME AND EFFORT, THE CLAIMS OF THIRD PARTIES, INJURY TO PROPERTY, OR ANY OTHER DIRECT, INDIRECT, SPECIAL, RELIANCE, INCIDENTAL OR CONSEQUENTIAL DAMAGES, REGARDLESS OF THE NATURE OF THE CLAIM AND WHETHER OR NOT FORESEEABLE, AND WHETHER OR NOT BASED ON BREACH OF WARRANTY, CONTRACT OR TORT OR STRICT LIABILITY, OR FOR ANY CLAIM BY ANY THIRD PARTY EXCEPT AS EXPRESSLY PROVIDED HEREIN.

For the sale of devices made to Customers within the United States, note that some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitations or exclusions may not apply to you. This Warranty gives you specific legal rights and you may also have other rights, which vary from state to state.

2.3 **Limitation of Liability. ANY DAMAGES THAT IROBOT SHALL BE REQUIRED TO PAY SHALL BE LIMITED TO THE TOTAL FEES AND CHARGES RECEIVED FROM CUSTOMER UNDER THIS AGREEMENT.**

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2.4 **No Liability for Delays.** iRobot and its suppliers shall not be liable for any damages caused by delay in delivery, installation or operation of the software or equipment under this Agreement.

2.5 **U.N. Convention on Contracts.** iRobot and Customer expressly agree that the United Nations Convention on Contracts for the International Sale of Goods (or its successor) shall not apply to this Warranty.

Problems within the Warranty Period

To make a Warranty claim, contact iRobot Government & Industrial Logistics Department by sending an email to maritimesupport@irobot.com or call +1 781 430 3030 for technical support. Provide the technical support representative with the Seaglider serial number and obtain a return merchandise authorization number (RMA#) and instructions for shipping to a designated repair facility.

Non-Warranty Repairs / Refurbishments

When non-warranty repairs, such as damage, or a refurbishment are requested, contact iRobot and an RMA Number will be issued to the Customer. The Customer is responsible for all shipping associated with non-warranty repairs. Upon receipt of the equipment, an evaluation will be performed and a Repair/Refurbishment Estimate will be forwarded to the Customer for review/approval. Prior to non-warranty repair work being initiated, a Purchase Order or other means of payment will need to be provided by the Customer. The limited warranty on repairs or refurbishments is sixty (60) days for labor and parts.

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